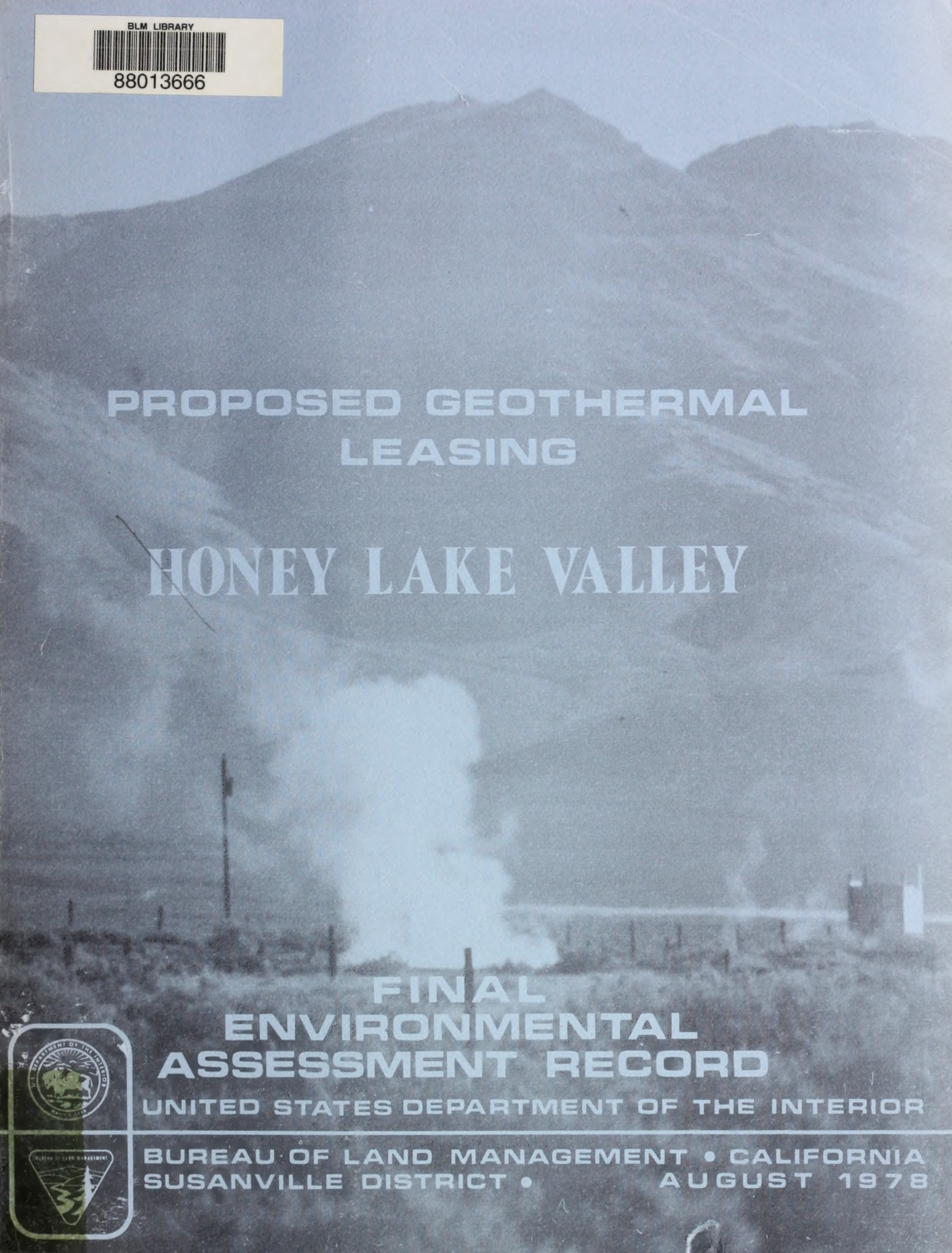

PROPOSED GEOTHERMAL LEASING

HONEY LAKE VALLEY

FINAL ENVIRONMENTAL ASSESSMENT RECORD

UNITED STATES DEPARTMENT OF THE INTERIOR

BUREAU OF LAND MANAGEMENT • CALIFORNIA
SUSANVILLE DISTRICT • AUGUST 1978

PROPOSED GEOTHERMAL LEASING

HONEY LAKE VALLEY

ENVIRONMENTAL ASSESSMENT RECORD

Department of the Interior
Bureau of Land Management
Susanville District

1791 (Honey Lake)

FINAL

Environmental Assessment Record

for

Proposed Geothermal Leasing

in the

Honey Lake Valley Geothermal Activity Area

SIGNATURES

Joseph M. McFarlan — 6/26/78

Joseph M. McFarlan
Team Leader — Date

Mark T. Morse — 6/26/78

Mark T. Morse
Area Manager, Eagle Lake Resource Area — Date

C. Rex Cleary — 6/26/78

C. Rex Cleary
Susanville District Manager — Date

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ABBREVIATIONS

AUM--animal unit month
BLM--Bureau of Land Management
BTU--British thermal unit
^{o} C--degrees centigrade
CDFG--California Department of Fish and Game
CFR--Code of Federal Regulations
CHZ--critical habitat zone
dB(A)--decibles on the A-weighted scale
EAR--environmental assessment record
EIR--environmental impact report
ERDA--Energy Research and Development Administration
^{o} F--degrees Fahrenheit
gpm--gallons per minute
GRO--Geothermal Resources Operational
H_2S--hydrogen sulfide
I.D.--inner diameter
kg--kilograms
KGRA--known geothermal resource area
km--kilometer
KW--kilowatt
MFP--Management Framework Plan
mg--milligrams
MW--megawatt
NO_x--nitrogen oxides
NRL--national resource land
ORV--off-road vehicle
ppm--parts per million
psi--pounds per square inch
R.--range
S.C.P.--single cell protein
SGEP--Susanville Geothermal Energy Project
SO_2--sulfur dioxide
SO_3--sulfur trioxide
spp.--species
T.--township
THC--total hydrocarbons
URA--Unit Resource Analysis
USC--United States Code
USDA--United States Department of Agriculture
USGS--United States Geological Survey
VRM--visual resource management

SUMMARY

Wilderness Resource Consideration

Introduction

Since passage of BLM's Organic Act (PL 94-579), Federal Land Policy and Management Act on October 21, 1976, consideration of public land for potential Wilderness Area designation is clearly mandated. Section 603 of the Federal Land Policy and Management Act of 1976 (Public Law 94-579) states that "..., the Secretary shall review those roadless areas of five thousand acres or more and roadless islands of public lands, identified during the inventory required by section 201(a) of this Act as having wilderness characteristics described in the Wilderness Act of September 3, 1964 (78 Stat. 890; 16 U.S.C. 1131 et seq.) and shall from time to time report to the President his recommendations as to the suitability or nonsuitability of each such area or island for preservation as wilderness: ..."

The evaluation of all roadless areas containing 5,000 acres or more and roadless islands of public lands must be made with respect to the wilderness characteristics found in Section 2(c) of the Wilderness Act of 1964.

> "Section 2(c): A wilderness, in contrast with those areas where man and his own works dominate the landscape, is hereby recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. An area of wilderness is further defined to mean in this Act an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation, which is protected and managed so as to preserve its natural conditions and which (1) generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value."

Since October 21, 1976, several instruction memorandums and solicitor's opinions have been issued to aid in defining interim management guidelines. Wilderness resource is to be evaluated and recognized" on the same basis as other multiple use values for which the Bureau is responsible" (OAD No. 77-29). Wilderness resource consideration will eventually be incorporated into the BLM Manual system. Bureau of Land Management draft procedures for wilderness are expected to be finalized by mid July, 1978.

For the purpose of the wilderness inventory, a road is defined as and must meet all of the following:

> "An access route which has been improved and maintained by using hand or power machinery or tools to insure relatively regular and continuous use. A way maintained solely by the passage of vehicles does not constitute a road."

Words and phrases used in the above definition of a road are defined as follows:

<u>Improved and Maintained</u>: Where actions have been and will continue to be directed to physically keep the road open to traffic.

<u>Relatively Regular and Continuous Use</u>: Use by vehicles having four or more wheels which has occurred and will continue to occur on a recurring basis, for a predetermined, planned, or intended purpose. An example would be access for equipment to maintain a stock water tank. Casual or random use by off-road vehicles or recreationists does not qualify.

The purpose of putting this discussion in the front of the Final EAR is to emphasize BLM's consideration of wilderness values in the Skedaddle-Amedee Area and its influence on geothermal leasing in Honey Lake Valley. Discussion of wilderness values and occasional reference to primitive values has been left in the text to expedite printing.

Existing Environment

Skedaddle-Amedee Area, Approximately 64,000 Acres

Prior to the Organic Act, the Skedaddle-Amedee Area had already been identified in BLM's planning process as having the highest primitive value in the Eagle Lake Resource Area (see MAP 25). The Cal-Neva Planning Unit Management Framework Plan (MFP) subsequently recommended 40,000 acres of designation as a primitive area.

Using the Wilderness Act of 1964 Section 2(c) criteria, several important resource values qualify the Skedaddle-Amedee Mountain Area as having wilderness characteristics. The Skedaddle-Amedee roadless area meets all characteristics necessary to be considered for wilderness study to some degree.

1. The area is recognized as an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. There are roads that intrude into the roadless area, some for as much as three miles, and they do meet the definition of a road and an intrusion but the sheer vastness of the area and their peripheral nature minimize such developments by man. These roads meet the definition of such because they lead to improvements both on public and private land, like springs and reservoirs, which means these roads are improved and maintained to insure relatively regular and continuous use. No roads completely traverse the area. All roads are of a peripheral nature and therefore large areas are left untrammeled by motorized vehicles.

2. It is an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation. The area is essentially undeveloped. On public land there are only a few fences, three reservoirs and one or two developed springs. Twelve miles of access road intrude into the roadless area, but none further than three miles. Four miles of way extend on from these roads. There are no permanent residences on 760 acres of private land within the outlined boundary of the roadless area. Private parcels are small and scattered.

3. The area generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable. No major construction or development is present within the boundaries of the area. As can be attested by hikers and campers who have visited the Skedaddle-Amedee area, the mountains and valleys do primarily reflect the action of nature as opposed to the disruption of man.

4. The area has outstanding opportunities for solitude, and a primitive and unconfined type of recreation. The Skedaddle and Amedee Mountains provide an excellent screen for those who wish to "get away from it all." Primitive and unconfined camping are also available. Many valleys require that water be carried along if one plans to camp there, because most drainages only run seasonally.

5. The Skedaddle-Amedee covers approximately 64,000 acres.

6. The area contains ecological, geological and other features of scientific, educational, scenic and historical value. Rugged, undisturbed terrain rising some 3,500 feet from the valley floor to a height of 7,574 feet (scenic value); evidence of Indian habitation sites in Wendel Canyon, Tommy Tucker and Amedee Caves in the Amedee Mountains (archaeological and educational value); numerous species of wildlife, including prairie falcon sightings on Amedee cliff, mountain lion at higher elevations and a potential California bighorn sheep reintroduction site (ecological, scientific and educational value); several prominent canyons, aspen groves on the northeast slopes of the Skedaddle Mountains (ecological, educational, scenic value); and excellent scenic views of Mt. Shasta and Mt. Lassen, Honey Lake Valley, Smoke Creek Desert to the east, the forested (often snow-capped) Sierra Nevada peaks to the south and the Diamond Mountain Range to the west.

The area has also been recognized by the local government as worthy of preservation. The Lassen County General Plan identifies the Skedaddle-Amedee Area as a prime recreation area, an area where significant resources should be "protected from spoilation or inappropriate development."

The Skedaddle-Amedee area does satisfy minimal Wilderness Act criteria and it is recommended for further study.

Little Mud Flat, Approximately 15,360 Acres

This roadless area meets three of the characteristics necessary to be considered for wilderness study but it fails to meet several other criteria.

1. It is an area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation. No large developments of any kind have been constructed within the boundary of the roadless area. There are no known permanent residences on public land. Private parcels of land within the boundary of the roadless area, except for state lands, are non-existent.

2. The area generally appears to have been affected primarily by the forces of nature, with the imprint of man's work substantially unnoticeable. The area is a combination of rolling hills and mountains with essentially a repetitive mixture of vegetation.

3. Little Mud Flat roadless area covers about 15,360 acres.

There are several characteristics which do not meet minimal wilderness criteria.

1. Little Mud Flat roadless area is not an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. Eight reservoirs, two small animal water sources, and one storage tank are located within but near the perimeter of the roadless area. Four of these developments have roads that are within the roadless area boundary. These roads meet the definition of a road, particularly where they have been improved and maintained. It is obvious that actions have been and will continue to be directed to physically keep the road open to traffic.

2. The area does not have outstanding opportunities for solitude or a primitive and unconfined type of recreation. Solitude requires being away and insulated from man and his impacts. There are two major factors which can contribute to solitude - distance and screening. With respect to distance, due to the configuration of the area's perimeter and the access roads which intrude it to reach reservoirs and private lands, there is very little of the unit which is more than one mile from a road or railroad. Southern Pacific railroad forms the boundary along much of the west side. Anywhere from 0-4 trains may pass by in a day. None of the area is more than two miles from a road or railroad. Therefore, the opportunity for solitude is minimal due to noise and visual intrusion around the perimeter of the roadless area.

Screening may be achieved by variation in topography and/or vegetation. Topography of the area consists of steep to gentle slopes without any deeply cut canyons or drainages. Interior and perimeter roads are in the viewer's immediate foreground from nearly anyplace in the roadless area. Vegetation is low desert shrub dominated by sagebrush and does not provide any screening. It is, in fact, a monotonous landscape without significant visual attraction.

3. The area is not known to contain ecological, geological or other features of scientific, educational, scenic, or historical values.

The Little Mud Flat area does not satisfy minimal Wilderness Act criteria and is not recommended for further study.

Impacts

The degree of disturbance is more important than the type of disturbance. It is consistently pointed out in solicitor's opinions that "study areas should be managed so as to preserve their wilderness characteristics but that all current activities can continue subject to controls in order to protect wilderness characteristics." House Report No. 94-1165, 94th Congress, 2nd Session at 17-18 (1976), included in Solicitor's Opinion to the Director, May 23, 1977. This point is clearly brought out in the Organic Act itself, quoted above, under Section 603(c).

Reading further in the same Solicitor's Opinion, "if proposed or current activities are discretionary (and geothermal leasing is), they should be conditioned in order to preserve the wilderness characteristics or the potential for future wilderness area designation. Thus, if a particular action is reversible, such as a road which can be scarified or livestock improvements such as fences which can be removed, it would be consistent with interim management for inventoried roadless areas. Difficulties arise only when actions are proposed which would destroy the potential of the area for ultimate wilderness designation."

The Little Mud Flat roadless area does not meet minimum Wilderness criteria under Section 2(c) and will not be studied any further.

The Skedaddle-Amedee roadless area does meet minimum Wilderness criteria under Section 2(c). Geothermal development under these circumstances is incompatible with wilderness characteristics.

Mitigation

Public land within the boundary of the roadless area, which may eventually become a wilderness area, must be so protected that any action taken will not "destroy the potential of the area of ultimate wilderness designation."

Three potential lease units are partially within the boundary of the Skedaddle-Amedee roadless area - numbers 2, 6, and 7. About 2,520 acres are affected. Mitigation for the study area is under Chapter IV, Human Interest Values, Recreation. It reads as follows:

2. Recreation

   a. The decision to lease or not to lease within the boundary of potential wilderness areas identified as Wilderness Study Areas will be deferred until their status as actual Wilderness Areas is decided by Congress.

   b. In order to protect the values of the potential wilderness area, construction of power plants will be at least one mile from the roadless area boundary. All other permanent facilities and structures within this one mile buffer zone will be assessed on a site-specific basis.

Unavoidable Adverse Impacts

As stated above, proposed activities shall be conditioned to preserve the wilderness characteristics or the potential for future wilderness area designation. By deferring the decision to lease or not to lease on those affected lands in potential lease units 2, 6, and 7, no unavoidable adverse impacts will occur to wilderness characteristics in these areas. Unavoidable adverse impacts to other resources in Little Mud Flat roadless area are identified in Chapter V.

Remarks

The following quote bears particular influence on the situation at hand. From the same Solicitor's Opinion, dated May 23, 1977: "Following completion of the inventory, Section 603(a) next requires the Bureau to study the suitability of the inventoried roadless areas for inclusion in the Wilderness System. At this point, the multiple-use trade-offs addressed by the BLM Planning System come into play. Congress envisioned that an area with all of the necessary wilderness characteristics might not be suitable for inclusion in the Wilderness System beacuse of its higher value for some other use, such as commerical forest management or mineral development."

Geothermal exploration should be allowed within the roadless study area, under 43 CFR 3209 regulations, to help BLM decide just this issue - do the wilderness characteristics outweight the areas' "higher value for some other use." This same issue will also be addressed in the report to the Secretary as a result of his causing "mineral surveys to be conducted by the Geological Survey and the Bureau of Mines to determine the mineral values, if any, that may be present in such areas." (PL 94-579, Section 603(a)).

INTRODUCTION

This document is in recognition of the Geothermal Steam Act of 1970 and subsequent related Federal government leasing and operating regulations (Title 43CFR - Part 3200 and Title 30 - Parts 270 and 271) which provide the major impetus under which leasing, exploration and development might occur commensurate with sound principles of multiple land use.

The proposed action of leasing national resource lands for geothermal development results from establishment of the Wendel-Amedee Known Geothermal Resource Area (KGRA) and receipt of six noncompetitive applications to lease geothermal resources. See Appendix 1 for definition of KGRA.

The purpose of this Environmental Assessment Record (EAR) is to identify those land areas within the study area which could sustain geothermal development without significant unavoidable adverse environmental impacts. Those lands which could be leased without such impacts are included in the Partial Lease Alternatives in Chapter VIII. If a decision is made to lease areas where significant unavoidable adverse impacts could occur, then an environmental statement will be prepared. The Federal lands involved, which are administered by the Bureau of Land Management (BLM), Susanville District, are located (See MAPS 1 & 2) northeast and southeast of Honey Lake. Federal lands in the Wendel-Amedee KGRA and noncompetitive lease application lands are located in T.27, 28 and 29N, R.15 and 16E, M.D.M., Lassen County, California, covering a total of about 10,324 acres (TABLES 1 & 2).

The study area is separated into two major blocks (See MAP 3) termed the Wendel-Amedee Area and the Island Area. Each block is separated from the other by a large tract of combined private and military-owned land. Within each study area, available federal land under noncompetitive lease application, federal land within the KGRA, and reserved mineral tracts have been organized into potential leasing units for purposes of analysis by each resource specialist (TABLES 1 & 2).

The Honey Lake Valley Geothermal Study areas (Wendel-Amedee and the Island) are located within the Honey Lake and Cal-Neva Planning Units. A Management Framework Plan (MFP) has been completed by the Susanville District for both of these planning units. The MFP contains management decisions for land use allocations, coordination guidelines for multiple resources use, and management objectives to be achieved.

The Honey Lake MFP recommends that the highest use priority for the Island area (potential leasing units 8, 9, 10, 11) is for geothermal development. In addition, waterfowl needs would be considered and ORV use would be allowed.

Revelant to the Wendel-Amedee area, the Cal-Neva MFP recommends:

1. The Skedaddle-Amedee Mountains (part of potential leasing units 2, 3, 7) be designated as a primitive area with the lands withdrawn from mineral exploration (and exploitation) and closure to all vehicles.

2. Highway 395 be designated as a scenic corridor. No new powerline rights-of-way would be allowed within this corridor, and ORV use would be restricted to existing routes. Both the scenic corridor and ORV closure affect most of potential leasing unit 1.

There are no special restrictions for the remainder of the Wendel-Amedee Area. It should be emphasized that the MFP is a dynamic document subject to continual review. Amendments can be made at any time new data becomes available.

The Wendel-Amedee Area contains a portion of the Wendel-Amedee KGRA, Federal land with pending noncompetitive lease applications (MAP 4), Federal land available for lease application, nonfederal lands and land patented under the Stockraising Homestead Act of December 29, 1916 (all minerals reserved to U.S.).

The Island Area contains a patchwork of Federal, nonfederal lands and land patented under the Stockraising Homestead Act. Most of the Federal land in the Island Area is covered by pending noncompetitive lease applications.

The distance between the Island Area and the next block of national resource lands is several miles to the southeast and these lands contain no applications to lease geothermal resources.

Within the boundaries of the Wendel-Amedee Area and the Island Area are approximately 20,725 acres of Federal land administered by BLM and 26,435 acres of land in private holding (See MAP 5). Legal descriptions of the areas being considered for leasing are given in Appendix 2.

The boundaries of the Wendel-Amedee Study area included for this analysis were selected because of the Wendel-Amedee KGRA as defined by the U.S. Geological Survey (USGS) and because of industrial geothermal resource interest outside the KGRA as expressed by three noncompetitive geothermal lease applications. The Island Area is included in this analysis because of three noncompetitive lease applications on national resource lands.

The Federal government has retained subsurface mineral rights on a total of 1,194 acres within both study areas. Approximately 320 acres lie within the boundary of the Wendel-Amedee KGRA and 874 acres lie in the Island study area. There are no other subsurface reserved minerals in either study area. The ownership of geothermal resources underlying such

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA
GENERAL LOCATION MAP

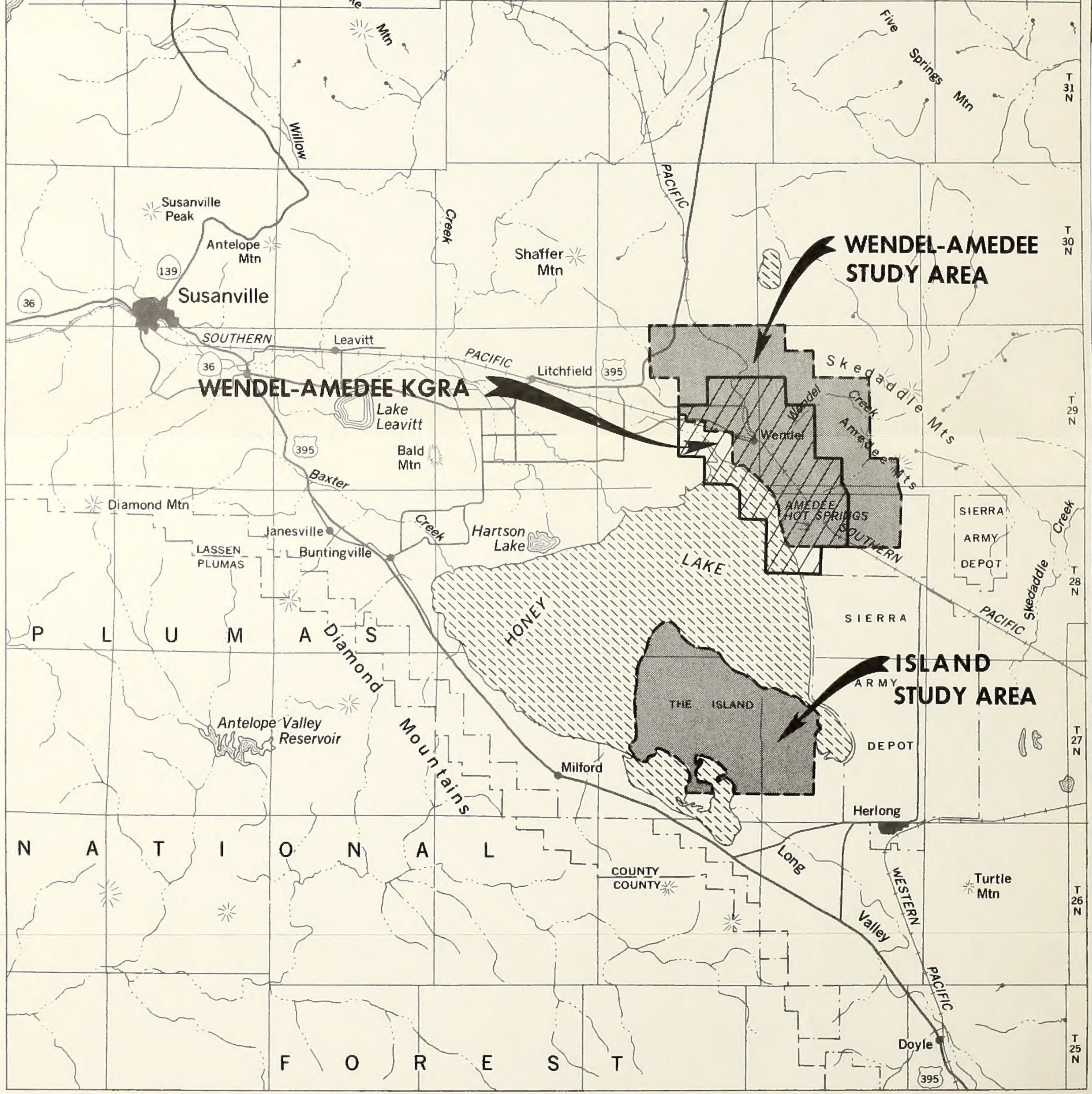

WENDEL-AMEDEE STUDY AREA
WENDEL-AMEDEE KGRA
ISLAND STUDY AREA
Susanville
Susanville Peak
Antelope Mtn
Shaffer Mtn
Five Springs Mtn
Leavitt
Litchfield
Lake Leavitt
Bald Mtn
Wendel
Skedaddle Mts
Amedee Mts
AMEDEE HOT SPRINGS
Diamond Mtn
Janesville
Buntingville
Hartson Lake
HONEY LAKE
THE ISLAND
SIERRA ARMY DEPOT
LASSEN
PLUMAS
Diamond Mountains
Antelope Valley Reservoir
Milford
Herlong
Long Valley
Turtle Mtn
Doyle
COUNTY
COUNTY
PLUMAS NATIONAL FOREST
SOUTHERN PACIFIC
WESTERN PACIFIC
Willow Creek
Baxter Creek
Wendel Creek
Skedaddle Creek
T 31 N
T 30 N
T 29 N
T 28 N
T 27 N
T 26 N
T 25 N

Table 1

POTENTIAL LEASING UNITS
HONEY LAKE VALLEY
GEOTHERMAL PROJECT

WENDEL-AMEDEE AREA

Potential Leasing Unit	Land Classification	Acres
1.	NRL Noncompetitive Lease Application CA 1266 **160 acres excluded	760
2.	NRL Noncompetitive Lease Application CA 1259	1,120
3.	NRL Noncompetitive Lease Application CA 1261 **719 acres excluded + Withdrawn 11-11-76	+
4.	Private* With Minerals Reserved to U.S.	320
5.	NRL in KGRA	1,205
6.	NRL in KGRA	1,322
7.	NRL in KGRA	1,600

Explanation: NRL = National Resource Lands
KGRA = Known Geothermal Resource Area
* = Land Patented Under Stockraising Homestead Act of 12-29-16 with all mineral reserved to U.S.
** = Acreages excluded because of improper legal description 3210.2-1(c)

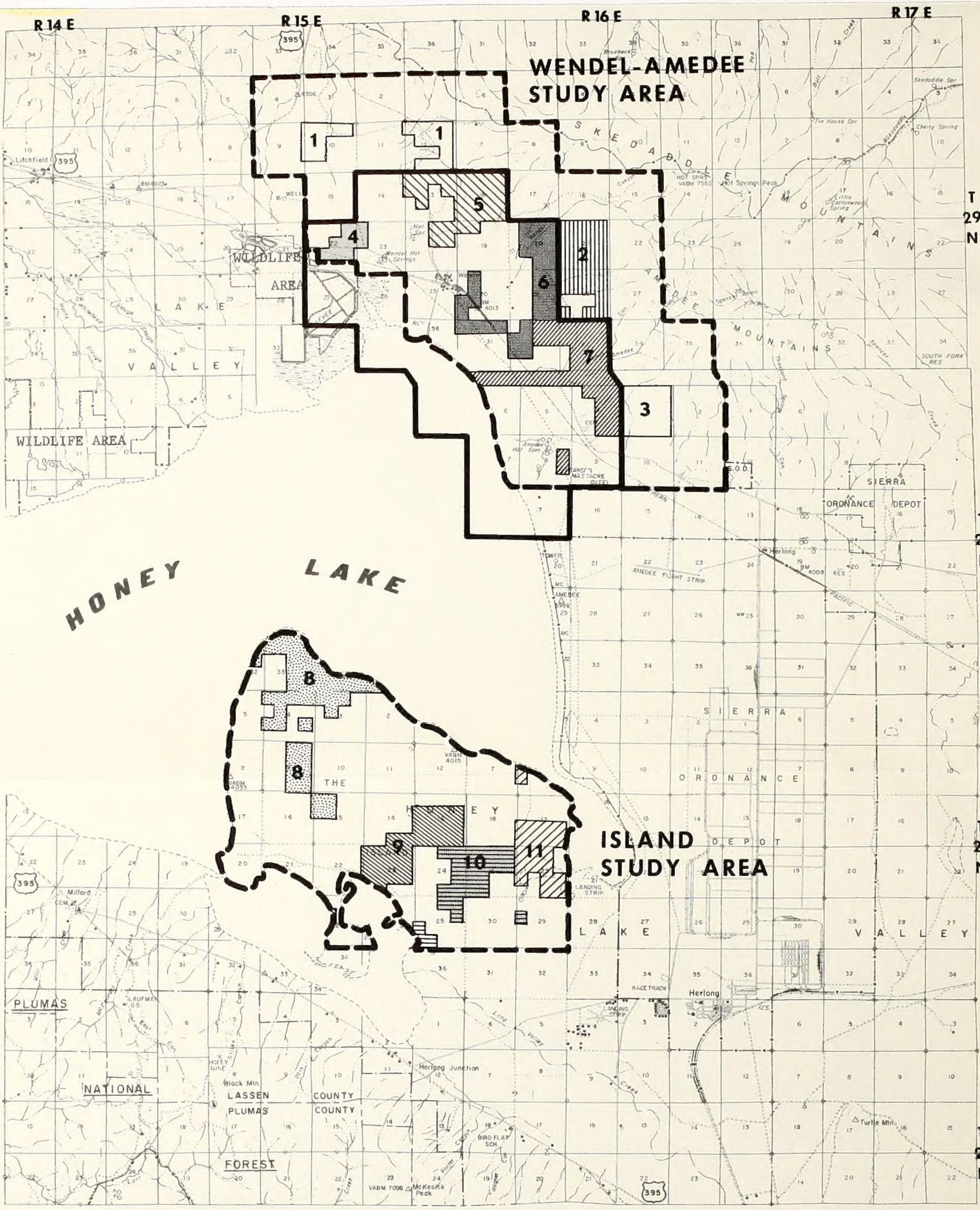
Table 2

POTENTIAL LEASING UNITS
HONEY LAKE VALLEY
GEOTHERMAL PROJECT

ISLAND AREA

Potential Leasing Unit	Land Classification	Acres
8.	NRL Noncompetitive Lease Application CA 1052	1,171
9.	NRL Noncompetitive Lease Application CA 1051 **52.83 acres excluded	1,056
10.	Private* With Minerals Reserved to U.S. NRL	874 53 927
11.	NRL Noncompetitive Lease Application CA 1027 **635.53 acres excluded	803
	TOTAL	10,324

Explanation: NRL = National Resource Lands
KGRA = Known Geothermal Resource Area
* = Land Patented Under Stockraising Homestead Act of 12-29-16 with all mineral reserved to U.S.
** = Acreage excluded because of improper legal description 3210.2-1(c)



LEGEND

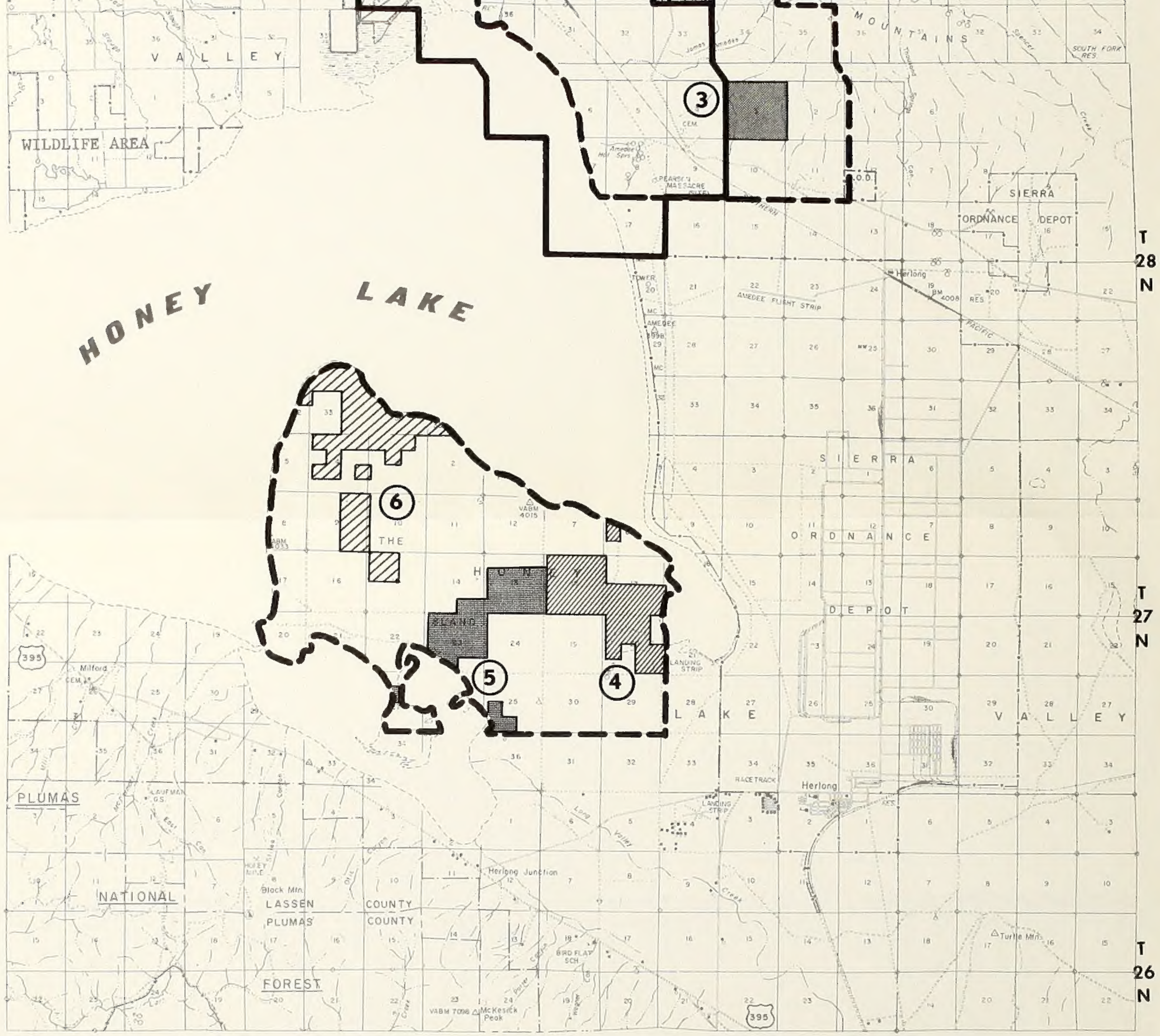
- Study Area Boundary
- Wendel-Amedee KGRA Boundary
- 10 Potential Lease Units
- Reserved Minerals (Stockraising Homestead Act of 1916)

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

POTENTIAL LEASE UNITS AND RESERVED MINERALS

MAP-3

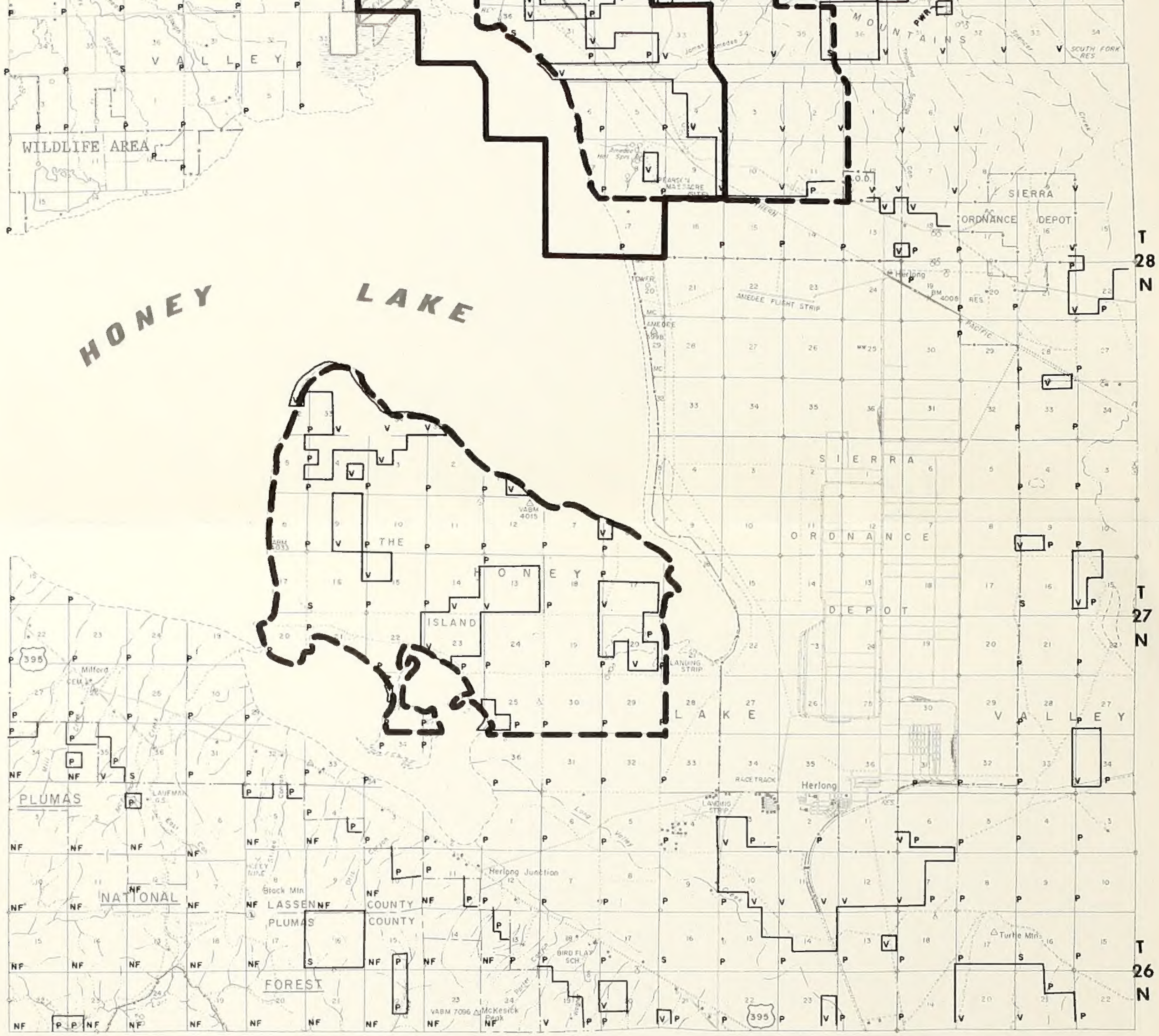
SCALE: ½" = 1 MILE   MT. DIABLO MERIDIAN



LEGEND

Study Area Boundary
Wendel-Amedee KGRA Boundary

1 Gulf Oil Corporation CA-1266
2 Gulf Oil Corporation CA-1259
3 Gulf Oil Corporation CA-1261 (Withdrawn)
4 Phillips Petroleum Company CA-1027
5 Phillips Petroleum Company CA-1051
6 Phillips Petroleum Company CA-1052



LEGEND

Study Area Boundary
Wendel-Amedee KGRA Boundary
V-Vacant National Resource Lands
P-Patented Lands
S-State School Lands
NF-National Forest Lands

lands has been the subject of litigation in the Ninth Circuit Court of Appeals. Quiet title action was brought by the Attorney General of the United States pursuant to section 21(b) of the Geothermal Steam Act of 1970, to determine whether the mineral reservation in patents issued under the Stock-Raising Homestead Act of 1916, reserved to the United States geothermal resources underlying the patented lands. The question is whether the right to produce geothermal steam passed to the patentees or was retained by the United States under this reservation. According to a copy of the Ninth Circuit Court proceedings, "review of the legislative history demonstrates that the purposes of the Act were to provide homesteaders with a portion of the public domain sufficient to enable them to support their families by raising livestock, and to reserve unrelated subsurface resources, particularly energy sources, for separate disposition". Therefore, because a potential for development exists on these lands, the above-mentioned parcels of reserved minerals (potential leasing units 4 and 10), it is necessary to consider the development potential of these lands.

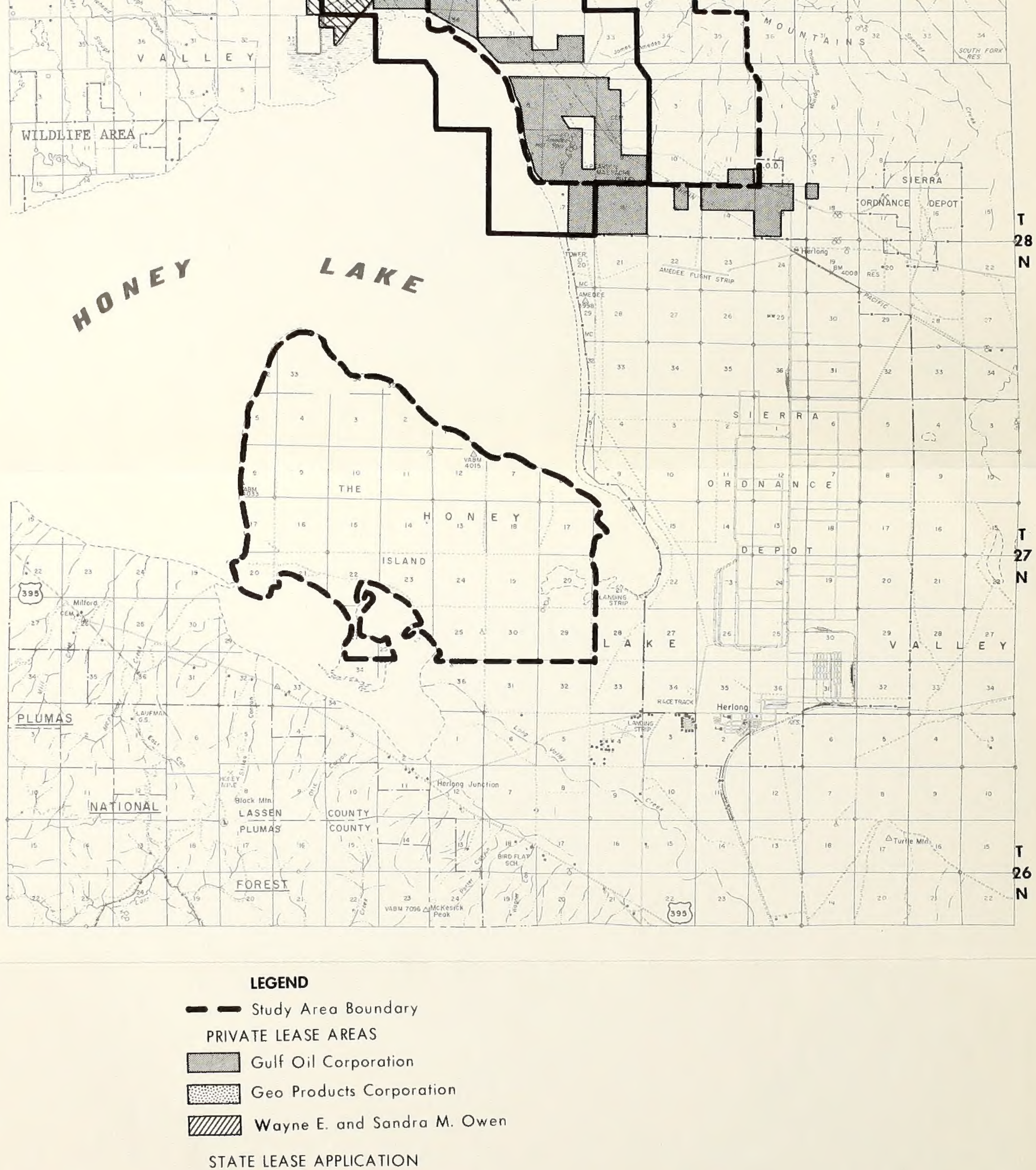
This analysis was prepared by an interdisciplinary team of BLM specialists composed of District and Resource Area personnel, State Office personnel and with the assistance of USGS in the Geology Section.

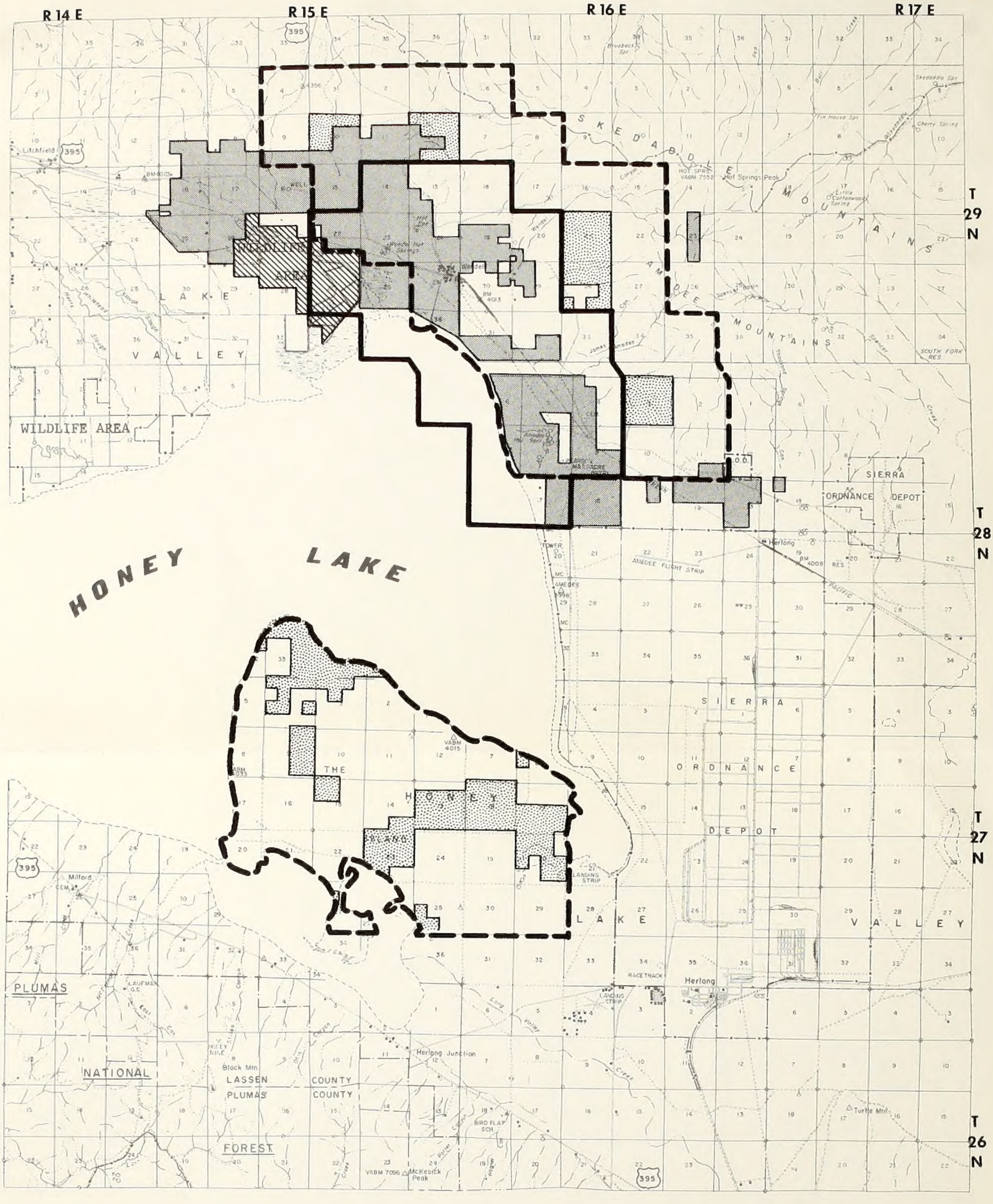
This EAR is a supplement to and a specific extension of the Interior Department's "Final Environmental Statement for the Geothermal Leasing Program", available in Interior Department Offices, public libraries and from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C.

In addition, although private lands were not specifically addressed in this analysis, where information was available, leasing potential on private lands among or adjacent to federal lands were identified (See MAP 6). A review of Lassen County Records at the County Court House, Susanville, California, revealed 29 tentative leasing agreements for private lands within proximity to the project area (APPENDIX 3). However, these agreements remain highly questionable for potential development until filed upon for county and State approval. The relative location of federal lease application areas and potential private lease tracts are shown on MAP 7.

On November 11, 1976, the Susanville District Office received a copy of a letter from Gulf Oil Corporation informing BLM that they were hereby withdrawing their geothermal lease application, serial number CA-1261. Portions of this lease application had already been rejected because all available lands in two sections were not included in the application (43 CFR 3210.2-1(c)). Therefore potential lease unit 3 has been effectively removed from further administrative action. The discussion of this unit has been left in the text to expedite publication.

The City of Susanville has been kept abreast of the Honey Lake Geothermal EAR. On April 20, 1976, Jim Jeskey, Susanville City Finance Director, was given a presentation of the BLM's intention to initiate a comprehensive EAR for the Wendel-Amedee and Island Areas. On July 14-16, 1976, Lassen College was the site for the Susanville Geothermal Energy Project Conference and Workshop. Engineering and planning consultants retained by the City of Susanville presented several papers on data collected and included findings and recommendations as appropriate. This information has been published in the Susanville Geothermal Energy Project, Workshop Proceedings, Final Technical Report, July 13, 1976. The Susanville Geothermal Energy Project has defined as one of its program criteria the "use of geothermal energy by a community for local economic development. Assume: The resource is there and technology is available." A more recent publication, the SGEP Summary Report, August 27, 1976, gives an analysis of a post-SGEP Survey and pertinent reports. Included in the appendix of the report is a copy of a preliminary City of Susanville Geothermal Policy. "This policy material is expected to evolve as required in developing the working interfaces between the City, County, private sector and inhabitants. At an appropriate time, a formal policy statement will be formulated." Most recently, on September 24, 1976, BLM representatives met with the City Manager and informed him of progress on the EAR and that a nonelectrical model had been developed and would be incorporated in the EAR. At this same meeting, the City of Susanville expressed an interest in a preferential geothermal lease or withdrawal of NRL for the purposes of local economic development. Consulting engineering and planning reports done fo the City have assessed geothermal prospects in Honey Lake Valley and determined that the Wendel-Amedee area has the highest subsurface temperatures recorded in exploratory wells. A preliminary geothermal policy statement in the SGEP Summary Report (82776) reads that it is an objective "to cause the development and use of geothermal energy in Lassen County and the vicinity of Susanville for the economic and social benefit of the local inhabitants." Further, a guideline is to "obtain rights to public owned geothermal resources only to that extent required for the fulfillment of the objectives of this policy." It is also stated: "In that the geothermal resources are located primarily in the county and in that the City has the responsibility for the economic well being of the largest segment of population, the development and use of the resources is best accomplished through a joint effort between the city, the county and the private sector."


VALLEY
WILDLIFE AREA
MOUNTAINS
SIERRA
ORDNANCE DEPOT
T
28
N
HONEY LAKE
THE HONEY ISLAND
SIERRA ORDNANCE DEPOT
T
27
N
LAKE VALLEY
Herlong
PLUMAS
NATIONAL
FOREST
LASSEN COUNTY
PLUMAS COUNTY
Herlong Junction
Milford
T
26
N
LEGEND
Study Area Boundary
PRIVATE LEASE AREAS
Gulf Oil Corporation
Geo Products Corporation
Wayne E. and Sandra M. Owen
STATE LEASE APPLICATION



LEGEND

- Study Area Boundary
- U.S. Lease Application Areas
- Potential Private Lease Areas
- State Lease Application Areas

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

FEDERAL LEASE APPLICATIONS
AND
POTENTIAL PRIVATE LEASE AREAS

MAP-7

SCALE: ½" = 1 MILE   MT. DIABLO MERIDIAN

I. DESCRIPTION OF PROPOSED ACTION

A. Proposed Action

Under the aegis of the Geothermal Steam Act of 1970, the Bureau of Land Management proposes to lease federally owned land for geothermal resource development in a portion of Honey Lake Valley, Lassen County, California.

1. Environmental Considerations

Implementation of the Geothermal Steam Act will infer the following actions:

1) Approval of "Notices of Intent to Conduct Geothermal Resource Exploration Operations" on areas not connected with a lease (Form 3200-9).

2) Issuance of Noncompetitive Geothermal Resource Leases (Form 3200-21).

3) Issuance of Geothermal Resources Leases in competitive-interest areas (Form 3200-21) by competitive bidding.

Each of these actions contain built-in environmental safeguards in the form of regulations which have been issued by the Secretary of Interior. This Environmental Analysis Record will analyze the proposed action and alternatives in light of these regulations through documentation of a detailed analysis of the anticipated impacts upon the existing environment as a result of the proposed geothermal leasing. Recommendations regarding mitigating measures and enhancement, along with information concerning irretrievable commitments of resources, will also be presented. Finally, an evaluation of the comments received from all sources at public meetings and through correspondence during and after the development of the report will provide assistance in determining whether leasing should be allowed or not and whether further study by way of an Environmental Impact Statement is necessary. For a more detailed discussion see Chapters IX and X.

Before any lease is issued, a technical evaluation of those lands proposed for lease will be performed. The evaluation conducted by BLM will consist of a Part 23 Technical Exam which will essentially be a compilation of the special stipulations to be attached to each competitive lease parcel and each noncompetitive lease application. The Technical Exam will be assembled after the decision has been made on which parcels will be leased. Stipulations will also be developed and attached to the Notice of Intent to Conduct Geothermal Resource Exploration Operations for specific lease sites to insure adequate mitigating measures to protect resource values.

Once the lands have been leased through competitive bidding on areas with competitive interests or by contractual agreement on lands with noncompetitive interests, lessees are required to submit a Plan of Operation to the U.S. Geological Survey before activity can begin. The plan is reviewed for compliance with applicable Federal, State and local laws and regulations. In addition, the plan must be compatible with lease and land-use permit stipulations of geothermal regulations, recommendations put forth in this EAR and stipulations developed in the pre-sale evaluations.

B. Background

Geothermal energy is useful for electrical power generation, space heating, process heating and recreation. Thus far the major interest in geothermal development has been for power production, although industrial and agricultural applications are beginning to generate serious interest.

The city of Susanville, located less than 25 miles northwest of the project area at its nearest point, is presently studying the feasibility of developing geothermal resources for a wide variety of uses. Until exploration, drilling and development actually begin, it is difficult to quantify the geothermal resource potential and, therefore, the intensified production measures necessary to develop it. Another problem exists because it is a comparatively undeveloped resource as far as technological developments are concerned.

C. Geothermal Resources

The earth is a tremendous reservoir of thermal (heat) energy. Heat flows beneath the surface and dissipates. This is usually not noticeable because it is dissipated in small quantities over the whole earth's surface.

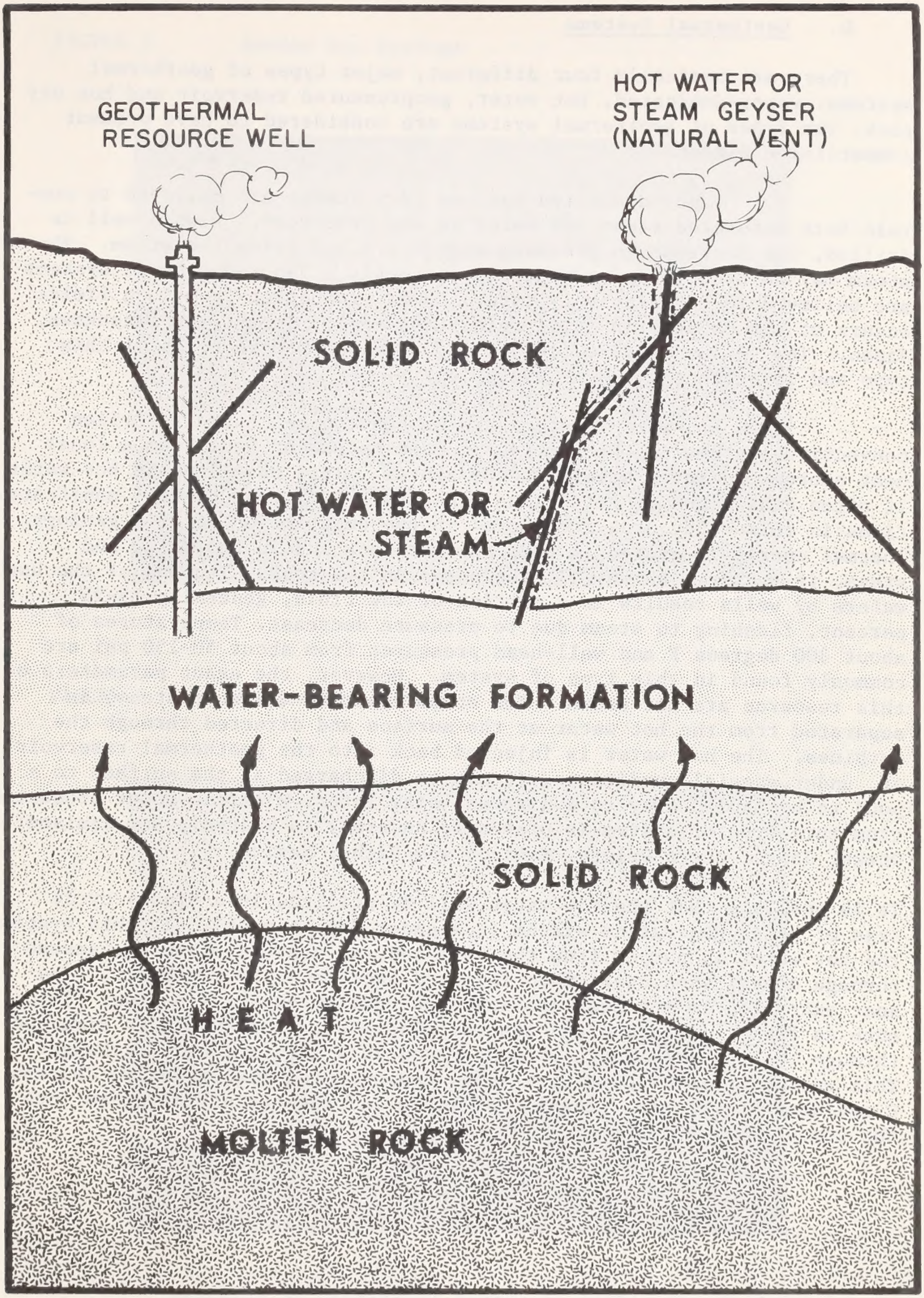
The increase of temperature with depth is called geothermal gradient. Normally it would average about 1^{o}F. for every 100 feet of depth. Some areas are discharging heat at rates of 10 to 1,000 times normal. These are the areas of interest for development of geothermal energy.

The heat source that creates these near-surface "hot spots" is either:

(1) A deep-seated magma (molten rock) from which the heat escapes via faults, or

(2) A shallow magma or magma cooling chamber in areas of fairly recent volcanic activity (within the last few million years).

Groundwater is heated by these energy sources and rises toward the surface. In some places, the hot water is trapped by overlying impermeable rocks. In others it reaches the surface through faults. Hot springs, fumaroles, mud pots and geysers are the surface expressions of such escape. (Figure 1).



CROSS SECTION OF GEOTHERMAL ANOMALY

Adapted from "Water and Power from Geothermal Resources in California" – California Dept. of Water Resources, Bulletin 190, 1974.

FIGURE I

D. Geothermal Systems

There are basically four different, major types of geothermal systems: vapor-dominated, hot water, geopressured reservoir and hot dry rock. Two types of geothermal systems are considered to have present commercial application:

1. Vapor-dominated systems (dry steam) are believed to contain both saturated steam and water in the reservoir. When a well is drilled, the decrease in pressure superheats and dries the steam. The steam may be used to drive a turbine directly. Vapor-dominated systems are believed to be relatively rare. Power production from such fields occurs at the Geysers in California; Lardarello, Italy; and Matsukawa, Japan. The Valles Caldera field in New Mexico appears to be of this type and is currently under development.

2. Hot-water systems are thought to be thermally driven convective systems in which meteoric water picks up heat from a local heat source and moves upward in the system. This upwelling of hot water if often manifested as hotsprings (Figure 2 & 3). Geothermal manifestations in this study area are listed in the description of area geology. Thermal energy is stored in both the hot rock and in the water and steam, if present, which fill the pores in the rocks. Tapping of the hot waters by wells results in a portion of the fluid, generally 15-25 percent, flashing to steam due to pressure decrease. Temperatures of about 300 degrees F and well-head pressures from about 50-150 psi are commonly found in this type of system. However, the exact parameters of this resource are not known. The steam fraction (flashed steam) is separated from the hot water at the surface and directed through the turbines. The hot water is injected back into the geothermal reservoir or, under special conditions, it may be discharged at the surface to a pond to be hauled away to a disposal site later. Electric power production from this type of system is presently underway in Wairkei, New Zealand; Otake, Japan; Cerro Prieto, Mexico; and Pathe, Mexico.

It is possible that the hot water will be utilized in a binary cycle type of power generation system (now under development). In this system the hot water is pumped from the well and, to prevent flashing, passed through a heat exchanger, then injected back into the reservoir. The heat extracted in the heat exchanger is used to vaporize a power fluid, such as freon, isobutane and others. The power fluid vapor is directed through the turbines and a condenser and back into the heat exchanger. This system operates best with water temperatures of 176 to 204 degrees C and does not require flashing of steam and the exhaust of steam into the atmosphere (Figure 4).

FIGURE 2 Amedee Hot Springs

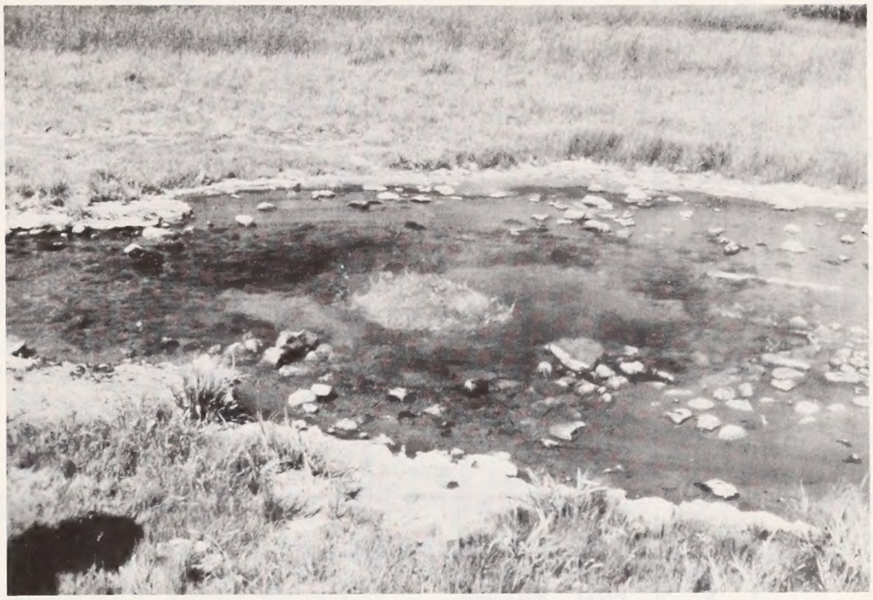


FIGURE 3 Amedee Hot Springs

Examples of Geothermal Resources within the Wendel-Amedee Study Area.

GEOTHERMAL POWER PLANTS

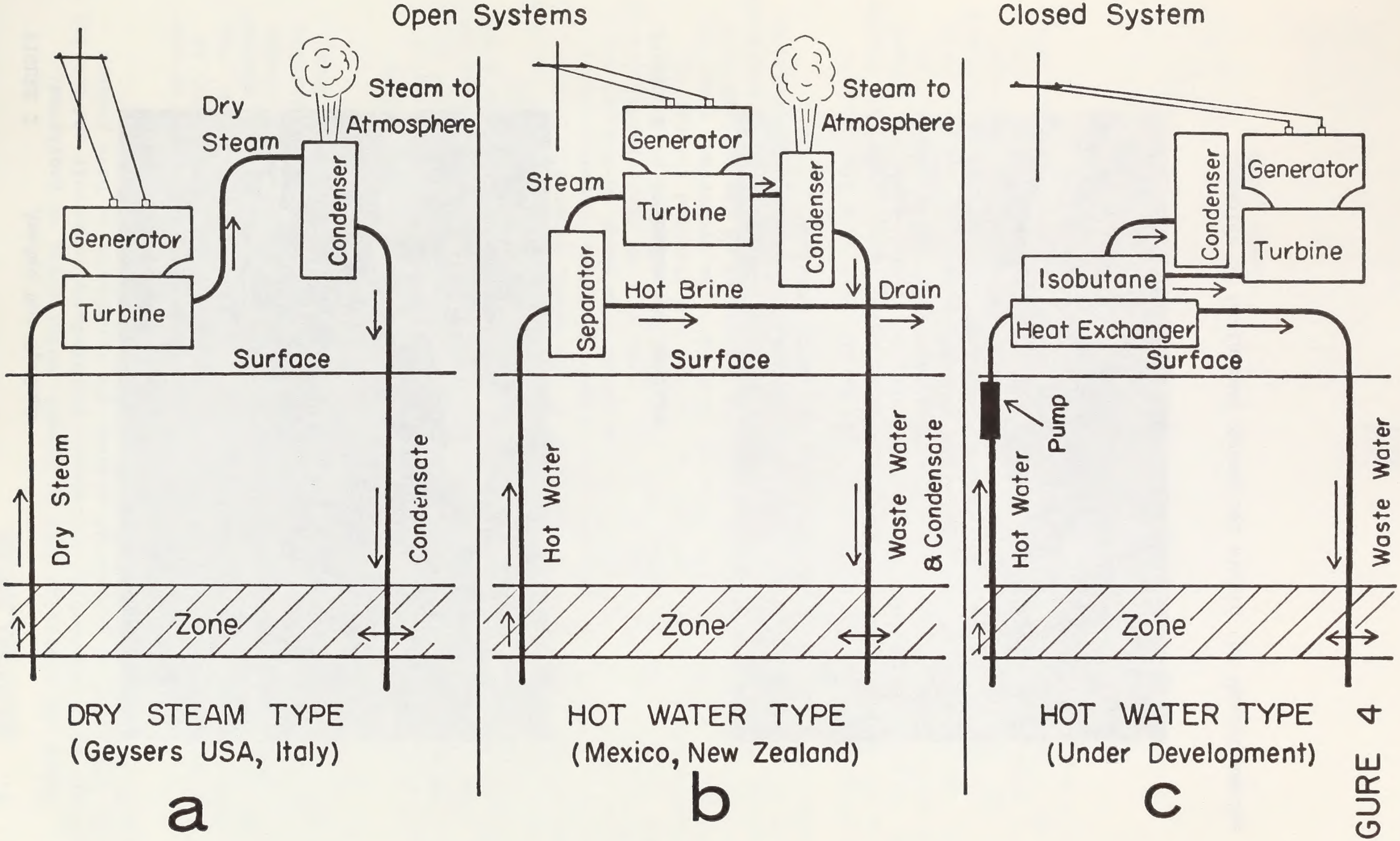


FIGURE 4

SOURCE: Interior, 1973: Vol. 2, p. V-15

E. The Wendel-Amedee Area

Exploratory work by the Bureau of Reclamation, "geological research to date, as well as the characteristics of known wells in the Susanville - Honey Lake Valley, would tend to indicate that the resource is likely to fall in the low to mid temperature ranges, i.e., 160° - 300°F regime" (II-13) SGEP Proc.). Gulf Oil has drilled two deep exploratory wells in the Wendel-Amedee area. Near Wendel, Honey Lake No. 2 - ST was drilled 5,056 feet deep and the maximum interval temperature logged was 248°F. Near Amedee, Gulf drilled a deep hole to 5,029 feet. A bottom hole temperature of 230°F was recorded. (V-14, 15 SGEP Proc.)

According to California Division of Oil and Gas, Geothermal Unit, in the publication "The Potential of Low Temperature Geothermal Resources in Northern California", Report TR13, "Hot water geothermal systems are... divided into two temperature ranges: (1) those above 160°C (320°F) capable of being used to produce electrical power and (2) those from 50°-160°C. Hot water systems above 160°C are economical for power production with present technology. If the thermal water is not hot enough to produce enough steam to be used directly or if surface and atmospheric pollution is a definite problem a binary cycle system may be practical. In this type of system, the heat is transferred to a low boiling point fluid, such as freon or isobutane, which expands and turns a turbine (FIGURE 4). At Paratunka, on the Kamchatka Peninsula, U.S.S.R., a freon-based generating unit is producing 0.7 MW (700 KW) using 81°C (178°F) water."

Fluid temperatures less than 300°F would suggest utilization of the hot fluid in nonelectrical systems. Data recently received from the USGS, Menlo Park, for use in the Wendel-Amedee EAR states that "Based on available data and demonstrated technology, the geothermal resource at Wendel-Amedee is inadequate for electrical power generation. Additional information derived from on-going and proposed investigations in the area may very well demonstrate the presence of a more significant resource than is indicated with present data. The presently identified resource could be very beneficial applied to nonelectrical uses." (Page 16, 22, USGS Input to Wendel-Amedee EAR, 1976).

Based on the geologic character of this region, the hot-water system appears as the most likely type to occur. Therefore, a hot-water system is assumed throughout the analysis (TABLE 3).

TABLE 3

SUMMARY OF SELECTED CHARACTERISTICS COMPARING VAPOR-DOMINATED AND HOT-WATER GEOTHERMAL SYSTEMS

Hydrothermal Convection Systems (relatively high temperatures at shallow depths)	General Environment of Occurrence	Temperature Characteristics	Nearby Surface Spring Discharges (liters per minute)
A. Vapor-dominated systems	Relatively tight, incompetent rocks that do not permit large quantities of recharge water to penetrate deep into their systems	240°C	100*
B. Hot-water systems	Permeable sedimentary or volcanic rocks and competent rocks such as granite that can maintain open channels along faults or fractures		Typical system discharges range from several hundred to several thousand liters per minute (lpm)
1. High-temperature systems		150°C	
2. Intermediate-temperature systems		150° to 90°C	
3. Low-temperature systems		90°C	

*Data from surface springs at The Geysers, California only.

Data generalized from: White and others, 1971; White and Williams, 1975.

F. General Resource Utilization

The full development of geothermal resources involves the harnessing of the natural heat energy sources in the earth for the generation of electric power, and several types of non-electrical utilization production of commerically valuable by-products.

Although geothermal steam as a source for electrical generation is the most actively pursued use, knowledge of geothermal resources is still, in large part, in the investigative stages. Commerical geothermal development in the United States to date is limited, existing only at The Geysers, in California, and there only since about 1960. By contrast, developments have existed in Italy since about the turn of the century.

Potential uses of geothermal resources are varied and, in addition to electrical generation, include space heating, agriculture, refrigeration, industrial processing, the production of fresh water by desalination, and the production of by-product chemical, mineral and gas resources (U.S. Department of Interior, 1973). In TABLES 4, 5, and 6, examples of present geothermal resource uses worldwide and in the United States are shown.

G. Chronology of Geothermal Development

Because geothermal development is a relatively new industry, its effects can only be evaluated, at best, on the basis of assumed success at various stages of development. Because of the limited knowledge of the occurrence, location and properties of geothermal resources, it is not possible to accurately predict success or failure of any lease program, even given the information to comprehensively analyze the natural resources of the area, in relation to the assumed basic stages of geothermal development. Until actual exploration and development of a geothermal resource area begin, it is difficult to quantify the extent of development potential and the site-specific conservative measures necessary to develop the resource. For the purposes of this analysis, therefore, assumptions have been made regarding development potential and the progress of the five basic stages of development with success of each stage dependent upon results of the previous stages. The combined effects of these stages of development and primary impact analysis through the production-stage level have been considered.

The five basic stages are: Preliminary exploration, exploration drilling, field development, production of geothermal resources and termination of operation or closeout.

1. Preliminary Exploration Stage

Exploration includes all activities from the decision to explore for a geothermal field through the drilling of one or more exploratory wells.

Table 4

Applications of Geothermal Energy
in the United States

Applications Now in Effect

ALASKA

1. Swimming pools and bathhouses
2. Greenhouses
3. Limited space heating

CALIFORNIA

1. Power generation
2. Space heating
3. Heating water for domestic use
4. Greenhouses
5. Spas and recreation
6. Lumber mill drying kilns

IDAHO

1. Space heating
2. Domestic hot water
3. Greenhouses
4. Swimming pools, resort use
5. Fish propagation (mainly catfish)
6. Irrigation
7. Animal husbandry (warm water watering during winter months)
8. Forest campgrounds

NEVADA

1. Source of water for domestic use
2. Space heating
3. Safe heat source for processing explosives
4. Spas and recreation
5. Greenhouses

OREGON

1. Space heating
2. Heating water for domestic use
3. Pasteurization
4. Industrial cleaning
5. Refrigeration
6. Coils under pavement to prevent accumulation of ice and snow
7. Greenhouses
8. Tree seedling nurseries

POSSIBLE FUTURE APPLICATIONS

1. Sugar processing
2. Fermentation processes
3. Freeze drying of food
4. Production of heavy H_2O
5. Mineral extration from brines
6. Production of alumina from bauxite
7. Gasification of coal and other carbonaceous
8. Textile processing
9. Products of fermentations: Ethyl alcohol, butanol acetone, citric acid, etc.

Source: Raschen, Rory and William Cook; Exploration and Development of Geothermal Resources, Internal Working Document, USGS, 1976.

TABLE 5

Applications of Geothermal Energy
Outside of the United States

HUNGARY

1. Greenhouses
2. Animal Husbandry
3. Space Heating
4. Crop Drying

ICELAND

1. Space heating on a large scale (40% of population)
2. Hot houses for flowers and vegetables
3. Industrial utilization
4. Power generation
5. Drying of seaweeds
6. Curing cement building slabs
7. Mining of diatomaceous earth
8. Fish Husbandry (salmon)

ITALY

1. Power generation
2. Chemical production
3. Ore processing

JAPAN

1. Space heating
2. Melting road snow
3. Sewage heat treating
4. Livestock barn heating
5. Egg hatching and poultry
6. Power generation
7. Tropical animal breeding
8. Tropical and food fish breeding eels
9. Greenhouses
10. Sapling growing
11. Soil disinfecting
12. Heating irrigation water
13. Cooking
14. Bathing
15. Heating swimming pools and fire fighting water
16. Salt making or desalting sea water
17. Tropical gardens

JAPAN (Continued)

18. Food drying, processing
19. Mineral water and medicinal
20. Rice processing
21. Extraction of gases
22. Production of sulfuric acid
23. Brewing and distillation
24. Raising alligators and crocodiles
25. Sinter extraction (alum)

MEXICO

1. Power generation

NEW ZEALAND

1. Process heat for newsprint pulp and lumber mills
2. Space heating
3. Power generation
4. Space cooling by lithium bromide absorption unit powered with geothermal heat
5. Biodegradation of wastes from pigsties
6. Washing and drying of wool
7. Soil and bulb sterilization
8. Tree seedling nurseries
9. Cooking and sterilizing garbage feed
10. Alfalfa drying

USSR

1. Domestic hot water
2. Space heating
3. Greenhouses
4. Soil heating (permafrost)
5. Industrial uses
6. Mining uses
7. Dairy farming
8. Power generation (experimental)
9. Iodine recovery

Source: Raschen, Rory and William S. Cook; Exploration and Development of Geothermal resources, Internal Working Document, USGS, 1976.

Table 6

TEMPERATURES REQUIRED FOR
VARIOUS GEOTHERMAL APPLICATIONS

Centigrade	
200	
190	
	Evaporation of Highly Concentrated Solutions
180	Refrigeration by Ammonia Absorption
	Digestion in Paper Pulp
170	Heavy Water via H_2S Processing
	Drying of Diatomaceous Earth
160	Drying of Fish Meal
	Drying of Timber
150	Alumina Via Bayers Process
140	Drying Farm Products at High Rates
	Canning of Food
130	Evaporation in Sugar Refining
	Extraction of Salts by Evaporation and Crystallization
120	Fresh Water by Distillation. Most Multiple Effect Evaporations,
	Concentration of Saline Solutions. Refrigeration by Medium
110	Temperatures
	Drying and Curing of Light Aggregate Cement Slabs
100	Drying of Organic Materials, Seaweeds, Grass, Vegetables, etc.
	Washing and Drying of Wool
90	Drying of Stock Fish
	De-Icing Operations
80	Space Heating
	Greenhouses by Space Heating
70	Pasteurization (harmful bacteria killed at 74.4°C or 166°F)
	Regrigeration by Low Temperatures
60	Animal Husbandry
	Greenhouses by Combined Space and Hotbed Heating
50	Mushroom Growing
	Balneological Baths
40	Soil Warming
30	Swimming Pools, Biodegrading, Fermentating
	Warm Water for Year-around Mining in Cold Climates. De-Icing
20	Hatching of Fish. Fish Farming.

Saturated Stream (110–200)

Water (20–120)

Temperature range of conventional power production (approx. 180–200)

Present expected temperature range for binary power plants (150–190)

Source: Raschen, Rory; and William S. Cook; Exploration and Development of Geothermal Resources, Internal Working Document, USGS, 1976.

Operations conducted under an approved "Notice of Intent to Conduct Geothermal Resource Exploration Operations," (43 CFR 3209) cover any surface disturbing techniques up to and including the drilling of shallow temperature gradient holes. Such operations do not include, however, the drilling of core holes for geologic information nor the drilling of exploratory geothermal wells.

Operations conducted under a geothermal lease (both competitive and non-competitive) include all exploration actions.

For convenience, exploration activities (as they relate to surface damage) may be classified into three discrete operations, two of which require physical presence on the land. They are:

a. Airborne exploration
b. Off-road vehicular travel
c. Road and trail construction

In practice, several of these operations may be going on concurrently. The technique is to start by evaluating large areas (i.e. several townships) and gradually reducing the area of interest. As the area of interest shrinks, more intensive exploration techniques are employed and targets are selected for drilling.

a. <u>Airborne Exploration</u> - This involves a series of techniques including:

i. Aerial photography - for geologic interpretation
ii. Imagery - infared to detect heat differentials; microwave to detect soil moisture differentials.
iii. Magnetic - airborne magnetometer measures variations in the magnetic intensity of the earth.
iv. Gravity - airborne gravimeter measures differences in the specific gravity of the earth.

All of these techniques are attempts to gain data on the subsurface geology of an area. The data gathered must be interpreted by specialists and may supply clues as to areas deserving of more detailed studies.

Airborne exploration produces no surface disturbance. It creates only a temporary negligible impact on air quality and noise levels.

b. <u>Off-road Vehicular Travel</u> - Many exploration techniques require off-road vehicular travel in various degrees. Generally, existing roads are used where possible. Techniques which sometimes require cross-country travel include:

a. Geological mapping - One or more small vehicles transport geologists to the work area.

b. Geophysical exploration - Includes a number of techniques seeking clues as to underground geology.

<u>Gravity</u> - Ground gravity surveys involve obtaining gravity readings along a surveyed grid with a portable gravimeter. A three-man crew does the work (two survey and the third records gravity readings). One or two small trucks transport the crew and equipment to the work area.

<u>Magnetic</u> - Magnetic variations are measured with a magnetometer. The field technique is similar to the gravity determination.

<u>Seismic</u> - Elastic shock waves are generated and measured along a grid system (generally 1-2 mile grid). Receivers (geophones) pick up elastic waves generated at a specific point on the grid. The elastic waves are generated by one of three methods:

<u>Vibration method</u> - Vibrations are produced by truck mounted vibrators, usually four, which operate in unison.

<u>Thumping method</u> - A truck-drawn or self-propelled unit containing a heavy weight or "hammer" drops the hammer on the ground to produce shock waves.

<u>Explosive method</u> - A truck-mounted rotary drill is used to drill holes 100-200 feet deep. These holes are loaded with 5-50 lbs of explosives and detonated (shot) to produce the elastic waves.

In all three seismic methods, 5-7 trucks and 10-15 men are required. Surface mineral matter and vegetation must be removed from the energy generation sites (shot points) and receiving sites (geophones) to provide for the maximum amount of energy to be sent and received. In addition, the explosive method often requires road construction, blading of lines and clearing of small areas for drill operation.

All three seismic methods involve varying degrees of surface disturbance. The explosive method produces the most intense surface disturbance. Only the explosive method possesses the potential for subsurface impact (damage to nearby water wells, damage to near-surface aquifers, etc.), and then, only within a limited radius of the shot point.

Microseismic - Small geophones called seismometers are buried at a shallow depth and transmit normal extremely minor seismic activity (microearthquakes) to an amplifier on the surface. The amplifier is about the size of a suitcase. Locations are set up away from roads to avoid traffic "noise". These units are often backpacked into areas inaccessible to vehicles.

Resistivity - Induced Polarization (IP) techniques are used to measure the resistance of subsurface rocks to the passage of an electrical current. A vehicle mounted transmitter sends pulses of electrical current into the ground through two widely spaced electrodes (usually about two miles apart). The behavior of these electrical pulses as they travel through underlying rocks is recorded by "pots" (potential electrodes), small ceramic devices that receive the current at different locations. The electrodes are either short (2-3 feet) rods driven into the ground or aluminum foil shallowly buried over an area of several square feet. Two or three small trucks transport the crew of 3 to 5 men to transmitting and receiving sites.

Telluric - A string of "pots" (potential electrodes) record the variations in the natural electrical currents in the earth. No transmitter is required. Small trucks are used to transport the crew to the work area.

Radiometric - Radioactive emissions (generally radon gas) are measured as an indication of subsurface steam. Such measurements are usually made in the vicinity of hot springs, hence existing roads are generally used. Measurements are taken with a hand held scintillometer.

c. Geochemical Surveys - Includes the sampling of spring water to determine dissolved solid content (acidity, Na/K ratio and silica content) and the taking of small (hand trowel) surface soil and rock samples on a grid system to determine introduced mineralization and source areas for recharge. Occasionally small trucks are used to transport the crew (usually 2-3 men) and equipment to the work area.

2. Exploratory Drilling Stage

Road and Trail Construction - For exploration activities utilizing large equipment in rough terrain with poorly developed access, roads and trails are often constructed. Since they are intended to provide only temporary access for such equipment as small drilling rigs and water

trucks, they are usually constructed to a very low standard--generally a 10-foot wide dozer trail is used in dry, stable country. Where larger drilling equipment is to be used for an exploratory well, a considerably higher road standard may be employed.

Drilling - Several types of drilling are utilized in the exploration phase including seismic test holes, temperature gradient holes, geologic or strategraphic information holes, and exploration wells. The size of the equipment and the surface area needed differs with each. The type of drilling used is rotary drilling which employs the principle of a rotating vertical pipe (drill stem) upon which has been mounted a rock bit designed to chip rock as it rotates under pressure.

Drill cuttings or chips produced as the hole progresses are removed from shallow shot-holes by introducing a jet of air during drilling. For deeper drilling, a circulating medium of water or mud (a suspension in oil or water of various finely-divided substances, each possessing specific properties) is pumped down the inside of the drill pipe and allowed to return up the annular space between the hole wall and outside of the drill pipe. This circulating medium is used to cool and lubricate the pit as well as to return the drill cuttings to the surface. Drilling mud helps prevent caving by plastering and consolidating the walls of the hole with a clay lining, thereby making casing unnecessary during shallow drilling.

a. Seismic test holes - Shallow holes 100-200 feet deep are drilled with small truck-mounted rigs. Cuttings are removed by compressed air. The surface area used is just sufficient for the truck and equipment. An area of about 30 x 30 feet is disturbed by the operation. No specific drill pad is built.

b. Temperature gradient holes - Shallow holes 300-500 feet deep are drilled with a small truck-mounted rig. The holes are usually between 4 and 6 inches in diameter. Mud is employed to remove the cuttings, and generally a portable metal mud pit is used to contain the mud. An area of about 30 x 30 feet is disturbed by use of the drill rig and servicing water truck. Usually no specific drill pad is necessary.

Upon completion of the temperature gradient hole a capped pipe (usually 3/4 inch diameter) is placed in the hole, and let stand for about a week. Water in the pipe is heated by the temperature of the surrounding rock. Because of the small diameter of the pipe, convection currents do not form, hence the water temperature in the pipe varies with depth. The temperature at different depths is measured by a thermister probe on a cable.

The following types of drilling are allowed only under a geothermal lease:

a. Geologic information holes - These holes are similar to those drilled for temperature gradient purposes. Larger equipment is employed and a surface area of about 40 x 60 feet may be used. The cuttings are examined and the hole is probed with geophysical instruments to acquire data on the rock types and structure. Because these holes may extend to 1,000 feet or more, a larger mud pit is needed. Typically, a mud pit is scooped out with a bulldozer. These pits may be 10-20 feet wide by 30-50 feet long by 3-6 feet deep depending on the terrain and the depth of the hole.

b. Exploration wells - These wells are the same as development and production wells. If successful, they are generally converted to production. Drilling equipment, technology and methods are similar to those used in oil and gas operations. Well bores of up to 24 inches in diameter may be drilled to depths of 5,000-10,000 feet.

Mud is generally used for the drilling. Where water flows are not encountered, compressed air may be substituted as the circulation medium. At the Geysers dry steam field, for example, mud is used to the depth that temperature interferes with proper operations, then compressed air is used. Noise created during the air drilling operation is intense and approximates that of an unmuffled diesel truck.

A drill pad is leveled and cleared of vegetation. This generally involves a surface area of from less than one acre up to two acres. The ancillary equipment is generally also located on the drill pad. A reserve pit of approximately 1,000 to 10,000 square feet and 6-8 feet deep is sometimes dug to contain waste fluids and drill cuttings during drilling operations.

The well is cemented and cased and a blow-out preventer is installed to control sudden surges of pressure.

Blow-outs are uncommon, but do occur. The basic problem is a lack of knowledge of the specific characteristics of a geothermal field. During the pioneering development in many fields around the world, blow-outs seem to have occurred in 1-3 percent of the test and production wells drilled. At the Geysers there have been three blow-outs with over 100 wells drilled. Since the Wendel-Amedee geothermal anomaly is water-dominated and appears to be low temperature (160-300°F) there is little reason to believe there will be as much threat of blow-outs due to high pressured - high temperature systems. For a more detailed discussion of the Wendel-Amedee area see Nonelectrical Model Development. Drill sites on old landslides in steep terrain at the Geysers caused much of the problem. Geothermal blow-outs cause no fire hazard and are generally controlled by slant drilling and water flooding prior to sealing with concrete.

While the blow-out is taking place, water, steam and contained elements are wasted and spread on the surrounding land.

The release of pressure and water through drill holes may affect the surface expression of the geothermal field. Springs and geysers may dry up, may be renewed in a different place, or may be increased. Accurate prediction of the results of drilling on such surface features cannot be made.

Since geothermal reservoirs are typically in active fault areas, normal earthquakes also occasionally change the surface features by drying up, moving or increasing thermal activity. It is thus not always possible to determine whether the observed effect was caused by drilling or by natural action.

Surface Disturbance - Models were not developed for each stage of lease implementation. For example, during the exploration stage surface disturbance is expected to be minimal, with few adverse impacts.

An exploration drilling model (TABLE 7) was considered and lists the maximum degree of surface disturbance expected during the exploration stage. This table and the others which follow tend to maximize the degree of surface disturbance which might occur. For example, fewer than five exploration wells may be needed, one acre per drill site could be used rather than two acres, disposal ponds may not be needed or could be smaller, and fewer access roads may be needed when roads into the area already exist.

Table 7

SURFACE DISTURBANCE EXPECTED TO RESULT FROM EXPLORATION DRILLING ON ONE 2,560-ACRE LEASE

Feature	Number of Acres Disturbed	Number of Features	Total Acres Disturbed
Well	2	5	10
Disposal Well	2	1	2
Disposal Pond	4	2	8
Access Roads	1.5	5	8
TOTAL			28 or 1% of total lease area

3. Field Development Stage

Depending upon the results of the exploratory stage, field development may occur. This may also be referred to as the production testing phase since it serves as a transition between exploration and production. The main activity involves drilling and testing of a number of wells to support a power generating plant should such development prove to be feasible. Discrete actions assoicated with the field development stage are, for the most part, the same as those described for the exploratory stage except that they are intensified. This stage could continue for many years. As it progresses, actions such as powerplant and associated facilities construction could be anticipated as well as the construction of facilities for the nonelectrical use of any low-temperature geothermal resources. Many of these operations would normally be taking place concurrently.

a. Road Development

During development, roads to new drill sites, powerplant sites, and along transmission line routes may be constructed. Roads to producing wells and powerplants will be permanent and may be surfaced and stabilized. Culverts will be utilized to avoid erosion of the road bed where necessary. Temporary roads constructed during exploration drilling to drill sites and new roads for construction of powerlines.

b. Drill Site Development

Wells drilled during the development stage will be similar to exploration wells. Often, somewhat larger equipment is used. The drill pad is leveled and cleared of vegetation. Generally from less than one up to two acres are disturbed. A reserve pit (sump) 1,000 to 10,000 square feet and 6-8 feet deep is sometimes dug to contain waste fluids during the drilling operations. The sump may be fenced to keep out animals.

Water - About 500-1,000 barrels (1 barrel = 42 gallons) of water per day will be used in drilling a well. This water may come from water wells drilled in the immediate vicinity (about 60 gpm flow would be adequate), from nearby surface water, or it may be hauled in by truck.

Spacing - Current geothermal plants require a steam pressure of about 100 PSI at the generator. This places a limit on the distance steam can be piped to the generator because of heat loss. Wells are therefore generally located withon one-half mile of the generation plant. The number of wells used to service a plant is dependent on the temperature of the wells (a temperature of 325-350°F at the generator is needed) and the characteristics of the geothermal reservoir. Generally, from 16 to 20 producing wells are used per powerplant.

At Cerro Prieto, 18 wells (3 are standby) will service a 75 MW generating plant. They are drilled on a 10 acre spacing (one well per 10 acres). A 40 acre well spacing is being used at the Geysers initially but future infill drilling to 20 acre spacing is planned in order to maintain steam production to plant capacity.

c. Intensive Well Development

To determine the sustained flow characteristics of a well, and to clean out the hole, each new well is vented to the atmosphere for a period of time. At the Geysers, enough experience has been gained as to the characteristics of the reservoir that this is no longer necessary there. Elsewhere it is an established practice. Wells in water-dominated systems are vented for a few days also. At a reservoir temperature of 150-160^{o}C, there should be about a 14 percent steam and 86 percent water mixture that reaches the surface.

Steam, water and noise accompany production testing. The water is generally directed into the reserve pit and is contained. The steam is released into the atmosphere.

Noncondensible gases (carbon dioxide, methane, hydrogen, nitrogen, argon, carbon monoxide, hydrogen sulfide, radon, ammonia) and vapors (boric acid and mercury) are often contained in the steam. These vapors and gases make up generally less than 3 percent of the total steam fraction (TABLE 8 and TABLE 9).

When present in excessive amounts, some of these gases and vapors are toxic.

Gas	Toxicity Levels
Ammonia	50 ppm
Boric acid	None established
Carbon dixoxide	5,000 ppm
Carbon monoxide	100 ppm
Hydrogen sulfide	20 ppm
Mercury	12.2 ppm
Methane	10,000 ppm

Where present in unacceptable amounts, monitoring devices and special precautions may be necessary as a safety measure and will be supplied by the operator.

Additionally, very small amounts of hydrogen sulfide (as small as .025 ppm) can be detected by smell. This "rotten egg" odor, common in hot spring areas, can be an aesthetic problem.

d. Well Venting

High noise levels accompany production testing. Because of this, muffling devices are generally installed. At the Geysers, measurements of noise from a muffled testing well indicates a noise level slightly less than that of an unmuffled diesel truck. Noise levels from a variety of activities are shown in TABLE 10.

Table 8

CONSTITUENTS CARRIED IN THE STEAM FROM WELLS AT THE GEYSERS FIELD[1]

Constituent		Concentration (mg/kg) (PPM) low	average	high	Average[2] Flow into 110 MW unit kg/hr	(lb/hr)
Carbon dioxide	(CO_2)	290	3260	30600	2700	5940
Hydrogen sulfide	(H_2S)	5	222	1600	1800	396
Methane	(CH_4)	13	194	1447	160	352
Ammonia	(NH_3)	9.4	194	1060	160	352
Boric acid	(H_3BO_3)	12	91	223	75	165
Nitrogen	(N_2)	6	52	638	43	95
Hydrogen	(H_2)	11	56	218	46	101
Ethane	(C_2H_6)	3	8	19	6.6	14.5
Arsenic	(As)	0.002	0.019	0.05	.016	.035
Mercury	(Hg)	0.00031	0.005	0.018	.004	.0088

[1]From measurements of 61 steam wells from 1972 through 1974.

[2]Based on steam input of 821,000 kg/hr (1,806,000 lb/hr.)

TABLE 9

EXAMPLES OF GASES ASSOCIATED WITH VARIOUS GEOTHERMAL SYSTEMS

	Geysers 1/ California	Larderello 1/ Italy	Matsukawa 2/ Japan	Namafjall 3/ Iceland	Wairakei 4/ New Zealand
H_2O	98.045	98.08	99.87	99.43	
CO_2	1.242	1.786	0.18	0.18	0.06
H_2	0.287	0.037	0.01	0.19	0.001
CH_4	0.299			0.01	0.0005
N_2	0.069	0.0105		0.05	0.0003
A			0.03		
H_2S	0.033	0.049		0.14	0.004
NH_3	0.025	0.033			0.0008
H_3PO_4	0.0018	0.0075			
C_2H_6					0.0001
H_3BO_3					0.00001
HF					0.000016

*Table adapted from "Final Environmental Statement for the Geothermal Leasing Program," U.S. Dept. of the Interior, 1973, Vol. 1, p. III-13.

1/ White, D. E., Muffler, L. J. P., and Truesdell, A. H., 1971, Vapor-dominated Hydrothermal Systems Compated with Hot-Water Systems; Econ. Geology, V. 66, p. 75-97.

2/ Nakamura, H., Sumi, K., Katagiri, K., and Iwata, T., 1970, The Geological Environment of Matsukawa Geothermal Area, Japan. U.N. Symposium on the Development of Utilization of Geothermal Resources, Pisa, Italy.

3/ Lindal, B., 1970, The Use of Natural Steam in a Diatomite Plan, U. N. Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy.

4/ Axtmann, R. C., 1975, Environmental Impact of a Geothermal Power Plant; Science, Vol. 187, No. 4179.

Noise levels from other geothermal fields, both vapor dominated and water dominated, may not be of a similar magnitude. Once drilling is completed noise levels will drop. The main source of noise in the field development and production stage would be:

(1) Steam venting from delivery lines. Noise levels average 100 dB(A) at 15 meters (50 feet) to 90 dB(A) at 76 meters (250 feet).

(2) Noise levels in and around generators varies from 40 to 90 dB(A) at 15.4 meters (50 feet). Where excess steam is being vented measurements as high as 92 dB(A) at 123 meters (400 feet) were found at Units #9 and #10 at The Geysers (Neilson, et. al., Francisco Leasehold, July 1975).

TABLE 10

NOISE

Activity	Noise Level dB(A)'
Air Raid Siren (100')	130
Steam exiting a Blow Line during Clean-out and Testing (50')	125
Jet Aircraft (200')	120 Threshold of pain
Amplified Rock Music (5')	110
Off-road Motorcycle (50')	90-105
Drilling Rig (air) (50')	102
Power Mower	100
Unmuffled Diesel Truck (50')	100
Truck Traffic Bringing Equipment and Supplies (50')	100
Steam Exiting a Blow Line with Muffler (50')	89-100
Road Building Equipment (50')	80-90
Steam Generating Plant (50')	85-90
Inside City Bus	90

TABLE 10 (Continued)

Activity	Noise Level dB(A)'
Motorcycle-2-Stroke Muffler (at source)	80 Danger Level
Pneumatic Drill (50')	80
Major Urban Freeway (100')	75-80
Street Corner in Large City (average)	75
Vacuum Cleaner (10')	70
Normal Conversation in Large Store	60
Interference with Sleep	55
Business Office	50
Average Residence, Quiet Room	40
Residential Area at Night (average)	40
Soft Whispers (5') Tick of Watch (2')	30
Studio for Sound Pictures	20
Leaves Rustling in Wind	10

Adapted from:

1. Final EIR, Vol. 3, Davies Estate in Lake County ENVIRONS, Las Altas, California.

2. ED & T 2428 Noise Reduction of Forest Service Equipment, USDA, Forest Service, San Dimas, California 91773.

3. ____________________ 1976, In Environmental Analysis Record, Randsburg, Spangler Hills, South Searles Lake, Proposed Geothermal Leasing. USDI, Bureau of Land Management, Riverside District, California.

4. Procunier, 1976.

e. Fluid Production and Associated Wastes

Production of geothermal fluids is likely for short periods during the exploratory phase as wells are tested to determine reservoir characteristics.

The rate of fluid production from a geothermal reservoir is unknown until the production testing phase is completed. However, using data from other areas of geothermal development is appears that production of geothermal fluids could be expected to vary from 440,000 gallons per day per well to 900,000 gallons. Assuming 670,000 gallons per day per well as an average production figure, a lease with 40 producing wells would yield 26.8 million gallons of fluid per day.

About 15-25 percent of the geothermal fluid produced from wells will flash to steam and be used to drive the turbines in the powerplants. Using 20 percent as an average, TABLE 11 lists the amount of geothermal fluid expected to be produced during testing of a 2560-acre lease.

TABLE 11

QUANTITIES OF FLUIDS PRODUCED DURING TESTING OF GEOTHERMAL EXPLORATION WELLS (15-day test assumed)

	1 Well (gal/ac ft.)	5 Wells (gal/ac ft.)
Fluid production	10,050,000/31	50,250,000/154
Amount converted to steam	2,010,000/6	10,050,000/31
Amount left for disposal	8,040,000/25	40,200,000/123

The most significant waste disposal problem relates to handling of the excess geothermal fluids. In vapor-dominated systems, as at The Geysers, about 75-80 percent of the water from the spent steam is consumed in the cooling towers, leaving 20-25 percent to be disposed of. In water-dominated systems, such as Cerro Prieto, Mexico, and most likely Honey Lake Valley, the reverse is true with 80 percent or more of the total well production requiring disposal. While some consumption of waste water would occur during recycling for nonelectrical uses, the waste water eventually requires disposal.

Disposal techniques vary, depending on the quality and quantities of effluent involved. Any or a combination of the following techniques may be employed.

a. Evaporation Ponds

Where water quality is satisfactory, such ponds may provide new aquatic habitat. Where water is toxic, special measures may be required to protect the groundwater supply, livestock and wildlife.

b. Natural Drainage Systems

High-quality water disposed of in this manner provides an additional resource for agriculture, wildlife and other uses. Low-quality water may require extensive treatment before it is suitable for release into natural drainages.

c. By-product Development

In some instances, it may be economical to extract useful minerals or gases from the geothermal fluids. This could result in improving the waste-water quality so as to make it available for other purposes. Desalinization may also be feasible in some areas, providing by-product fresh water for other uses.

d. Reinjection

With this technique, excess water is reinjected into nonproductive zones of the geothermal field. Successful reinjection is dependent on the quality of the waste water and the geologic characteristics of the geotherma field. Typical considerations would include: whether plugging and scaling problems will prevent the reservoir from accepting the fluid; whether fresh-water aquifers can be adequately protected from contamination by hot saline waste water; and whether the subsurface rock structure will adequately hold the reinjected fluids.

TABLE 12 lists the quantities of fluids expected to be produced on one 2560-acre lease.

Cooling towers consume about 40-45 acre-feet of water per year for each megawatt of plant capacity (U.S. Department of Interior, 1975). Two 100-megawatt plants would thus consume about 9,000 acre-feet of water per year (25 acre-feet per day). The water may come either from steam condensate, waste geothermal water or from development of groundwater.

Noncondensible gases (carbon dioxide, methane, hydrogen, nitrogen, argon, carbon monoxide, hydrogen sulfide, radon, ammonia) and vapors (boric acid and mercury) are often contained in the steam. These vapors and gases generally make up less than 3 percent of the total gas fraction. TABLE 9 lists examples of gases associated with various geothermal systems.

TABLE 12

QUANTITIES OF FLUIDS PRODUCED DURING PRODUCTION AND OPERATIONS

(One 2560-acre lease per day)

	1 well (gal/ac ft.)	10 wells (gal/ac ft.)	40 wells (gal/ac ft.)
Fluid produced	670,000/2	6,700,000/20	26,800,000/82
Amount converted to Steam[1]	134,000/.4	1,340,000/4	5,360,000/16
Amount left for reuse before disposal	536,000/1.6	5,360,000/16	21,440,000/66

[1] Steam can be condensed and put to beneficial use.

If geothermal production releases substances found to be detrimental to the environment, these substances must either be removed or otherwise disposed of before surface disposal occurs. If no harmful materials are present, or if these materials can be economically removed from the fluids, it is possible that fresh water can be produced with the energy. Conservation and utilization of such demineralized water will be encouraged where such production is economically feasible.

The work force (both construction and maintenance) for a geothermal powerplant and/or nonelectrical development will probably be housed in the nearest town rather than a new town at the site. Thus, waste materials connected with human habitation will typically be handled in the local community.

At the plant site itself, sanitary facilities for workers would be provided. Solid wastes would either be disposed of in a dump developed at the site or trucked to the nearest established dump site.

F. Geothermal Pipelines

Pipelines 10 to 30 inches in diameter will be used to transmit steam or hot water from the production wells to the powerplants. The pipes are typically insulated with fiberglass or asbestos to minimize heat loss. Expansion loops or joints are placed at frequent intervals either vertically or horizontally to provide for the extreme expansion and contraction of the pipes upon production start up (heating up) and shutdown (cooling down).

Under present technology, pipelines are constructed above ground to provide for expansion and contraction and to enhance maintenance and detection of leaks. Underground installation is thus far uneconomical and may also present some safety hazards.

The lines form a radiating pattern on the surface, connecting wells with the powerplant.

G. Plant Construction

At the present time, it takes approximately five years to hold the necessary hearings and review the environmental impact report before a Certificate of Public Convenience is issued. Similar procedures will be required for powerplant siting on Federal lands. At The Geysers, a permit was requested July 19, 1972 and The California Energy Commission approved construction in March, 1976. Construction of the powerplant requires an additional two years. Thus, there may be up to five years from the initial permit request until operation of the plant can begin.

The following discussion assumes full development of one 2,560 acre Federal lease. Maximum electrical development is estimated to consist of two 100-megawatt powerplants sited about one mile apart.

Construction activities required to develop two 100-megawatt powerplants, associated wells, pipelines, roads and transmission lines are listed in TABLE 13. The number of wells includes those used for production, for standby and for injection. Since development is likely to occur in about 50-megawatt increments over a period of several years, the degree of surface disturbance at any given time is less than assumed in the model. Mitigation and enhancement will have occurred in some portions of the lease before additional portions of the lease are developed.

TABLE 13

SURFACE DISTURBANCE--DEVELOPMENT
OF TWO 100-MEGAWATT POWERPLANTS
(One 2560-Acre Lease)

Feature	Acres Disturbed Per Feature	Number of Features	Acres Disturbed
Powerplant	5	2	10
Well (40 producing; 25 injection)	2	65	130
Disposal Pond*	4	5	20
Pipeline	1.2	65	78
Access Road (spurs)	0.9	65	59
Mainline Road	12	1	12
Transmission Line	4.5	2	9
TOTAL			318 or 12% of total lease area

*Left over from exploration. May be utilized during field development along with injection wells, or may be abandoned and rehabilitated.

Geothermal fluids and steam for electrical power production can be transported only a distance of about one mile due to pressure and temperature loss factors; the greatest distance of any connected well currently is 1,200 feet in a straight line. Transportation of fluids for use in nonelectrical projects is considerably farther (See TABLE 15). Powerplant installations will be relatively small, probably not exceeding 100 megawatts at individual sites. A typical powerplant at The Geysers consists of two turbine generators housed in a single building with an adjoining structure housing cooling towers. The Geysers Units 3

and 4 are housed in a building 140 feet by 34 feet and 30 feet high. Adjoining is a cooling tower consisting of three shells 36 feet by 66 feet.

TABLE 14 lists similar data for one 50-megawatt powerplant.

Rehabilitation will be possible on disturbed areas not needed for continued production, commensurate with terrain, climate and significance of the damage. Roads needed for maintenance and further development will not be rehabilitated. Temporary roads and trails can be scarified and revegetated.

After well completion, an area approximately 30 feet by 30 feet directly surrounding the well head will be needed for operation. An additional graded area about 50 feet by 100 feet may be needed for moving in a drilling rig to correct any problems which may develop during production. The reserve pit (sump) is generally dried out, covered with dirt and graded. It and the remaining area of the drill site can be rehabilitated and revegetated.

TABLE 14

SURFACE DISTURBANCE--DEVELOPMENT
OF ONE 50-MEGAWATT POWERPLANT
(One 2560-Acre Lease)

Feature	Acres Disturbed Per Feature	Number of Features	Acres Disturbed
Powerplant	3.5	1	3.5
Well (10 producing; 6 injection)	2	16	32
Disposal Pond*	4	5	20
Pipeline	1.2	16	26
Access Road (spurs)	0.9	16	14
Mainline Road	12	1	12
Transmission Line	4.5	1	4.5
TOTAL			112.0 or 4.4% of total lease area

*Left over from exploration. May be utilized during field development along with injection wells or may be abandoned and rehabilitated.

4. Production of Energy Stage

This phase starts upon reaching commercial power production. Exploration and development are typically carried on in other parts of the geothermal field simultaneously with the operational activities.

This stage may be divided into the following discrete operations:

a. New drill sites
b. Construction of transmission lines
c. Production and operation stage
d. Maintenance

a. Additional Well Development

Intensive well development has been discussed in the previous section. Exploratory drilling may have involved five or more wells (TABLE 7), whereas development necessary for two 100-megawatt powerplants might involve 65 wells (TABLE 13). An additional 60 wells may be necessary to support full development.

Geothermal fields are long-lived resources. The Lardarello field has been in production since 1904 and The Geysers since 1958. The Geysers is estimated to have a minimum productive life of 30 more years. Nonetheless, production slowly dimishes the heat flow and additional wells must be drilled and completed to keep the generating plant operating at full capacity.

Additional wells may also be required to replace wells that have become inoperative and, if the waste waters are disposed of by injection, injection wells may be drilled.

The technique and effect of these wells would be the same as for development wells. On a major producing field, it can be expected that one or two drilling rigs would be operating continuously throughout the life of the field drilling additional or replacement wells.

b. Transmission Lines

Power generated from the plant is transmitted via conventional power-lines to the area of use. The size and location of the lines is dependent upon the power output and destination.

The lines will tend to be large, considering that 1 MW of plant capacity will service the power needs of about 1,000 people. To express this another way, one 110 MW powerplant could supply the power needs of the City of Reno.

Electric power generation up to about 30-35 megawatts could be transported over existing powerlines to users in Honey Lake Valley and Susanville. Full development of a Federal lease would require construction of additional transmission lines to export power to outside areas. Some of the power might be exported through existing lines towards Westwood and a tie with Plumas Sierra Rural Cooperative is possible.

Transmission-line construction requires acquisition of at least a 90-foot right-of-way, construction of access roads, clearing of portions of the right-of-way, hole drilling, emplacement of poles or towers, stringing of wire and rehabilitation of disturbed areas.

c. Production and Operation Stage

During the production and operation stage, activities primarily will consist of the operation and maintenance of the powerplant and existing wells, the drilling of new wells, waste disposal and water utilization. Electrical energy generation during full-scale operations will be at its maximum and generally may be expected to continue at approximately the full-scale level for many years. The overall activity, however, will be considerably reduced over that required during field development and construction of power generation, power transmission and related facilities.

Exploration and development are typically carried on in other parts of the geothermal field simultaneously with the operational and production activities.

Repair, maintenance, and monitoring of an operating field require the periodic use of access roads to service the equipment. Existing wells will require occasional repair work or cleanout. The amount of the remedial work will depend upon the production characteristics of the field. Severe scaling and corrosion of equipment from chemicals encountered during development would require frequent remedial work. Normally one medium-sized drill rig would be required to drill new wells to maintain generating capacity.

Geothermal fields are long-lived resources. The Lardarello field has been in production since 1904 and The Geysers since 1958. The Geysers is estimated to have a minimum productive life of 30 or more years. Nonetheless, production slowly diminishes the heat flow at individual wells and additional wells must be drilled and completed to keep the generating plant operating at full capacity.

Additional wells may also be required to replace wells that have become inoperative and, if the waste waters are disposed of by injection, new injection wells may be drilled. The technique and effects of drilling these wells would be the same as for development wells.

The most significant waste disposal problem relates to handling the excess geothermal fluids. In vapor-dominated systems, as at The Geysers, about 75 to 80 percent of the water from the spent steam is consumed in the cooling towers, leaving 20 to 25 percent to be disposed of. In water-dominated systems, such as Cerro Prieto, Mexico, and most likely Randsburg, the reverse is true with 80 percent or more of the total well production requiring disposal.

Disposal techniques vary. Current techniques have previously been discussed under Fluid Production and Associated Wastes, Section 3.

Production from a geothermal field will generally require 2-5 people per plant to inspect, adjust and service the wells, making the rounds about once each day on the existing road network.

Sustained production will have several effects:

1. Temperature drop - The field will gradually realize diminishing temperatures as the energy is utilized.

2. Water utilization - Cooling towers will consume about 40-45 acre feet of water per year for each megawatt of plant capacity. Each 110 MW plant would thus consume about 5,000 acre feet of water per year. The water may come either from steam condensate, waste geothermal water, or from any other water source. This water consumption might be reduced by use of some technique other than conventional cooling towers. One such scheme, called the "night stream cooling system" would theoretically use only 42 percent as much water.

3. Subsidence - As large volumes of water are pumped from a geothermal reservoir, some subsidence of the ground surface may occur. In many cases, subsidence may have no serious land use or environmental consequences. In some situations, such as developed agricultural land under gravity irrigation, minor surface subsidence could have a significant impact. Continuous monitoring might be necessary to detect whether subsidence was occurring. In some instances, re-injection of the waste water might correct subsidence problems.

4. Seismic activity - Geothermal areas are typically associated with seismic activity. Such activity is generally of small magnitude (usually less than 4.5 on the Richter scale). Fluid pressure changes from both production and re-injection may tend to increase earthquake frequency, though the relationship is not well known. To date, such earthquakes have been small and there is some evidence to suggest that this minor seismic activity tends to relieve regional stresses and diminishes the likelihood of large earthquakes. Earthquakes sometimes modify geyser activity and may effect other geothermal features such as hot springs.

d. Maintenance

Repair, maintenance and monitoring of an operating field will require the periodic use of access roads to service the equipment. Existing wells will require occasional repair work or cleanout. The amount of this remedial work will depend upon the production characteristics of the field; severe scaling and corrosion would require frequent remedial work. Normally, one medium-sized drill rig would be required full time for each 20-30 wells (one 110 MW powerplant).

5. Integrated Electrical and Nonelectrical Development

Considering the characteristics (see Nonelectrical Field Development, next page) of the Wendel-Amedee geothermal reservoir based on available exploration data, the possibility of other economic uses of the thermal fluids must be explored. The possibility of a combined electrical and nonelectrical production system does exist. The idea is being assessed by the City of Susanville. There is also the possibility that a totally nonelectric development may be pursued. This is discussed in further detail under Nonelectrical Field Development.

Heated waste water from one or more geothermal powerplants could be utilized at agricultural-industrial parks located adjacent to powerplants or heated waste water could be transported to utilization sites outside the lease area.

According to Bernard B. Bassee, VTN Consolidated, Inc., in his discussion of Thermal Energy Utility Systems in the SGEP Workshop Proceedings, "water has one of the highest heat capacities of all known fluids. As a consequence, it loses its heat slowly and can be transported great distances in pipe with small temperature lossses. A 30 inch underground foam insulated asbestos cement pipe, for instance, flowing at 7 feet per second, can theoretically carry 210°F inlet water a distance of 100 miles with a loss of only 9°F. TABLE 15 illustrates temperature losses for 100 mile lengths of underground pipe fabricated from bare and insulated steel and asbestos cement. So long as pipes are large and operated at design velocities, losses remain small. Assuming use of heat in the water down to 120°F, it may be noted that even uninsulated steel pipe can carry inlet water at 300°F, a distance of 100 miles with a loss of only about 25 percent of its usable heat".

TABLE 15

TRANSMISSION OF GEOTHERMAL ENERGY
IN A 100 MILE LONG 30-INCH I.D. PIPE

Pipe Material Construction	Temperature ^{o}F In	Out
Uninsulated		
Steel	300	258
Asbestos Cement	210	185
Insulated		
Steel	300	283
Asbestos Cement	210	201

*100% Utilization

For analysis purposes, a 50-acre tract located adjacent to each powerplant is assumed adequate space for future economic growth. This is a total of 100 acres per potential lease site. Surface disturbing activities such as access roads and pipelines are thereby minimized if developed along with electrical generation. Each resource specialist will analyze potential lease sites as if only nonelectrical development were to take place. If electrical and nonelectrical development were to occur concurrently, surface disturbance would be further minimized. With these assumptions, the degree of surface disturbance shown in TABLE 13 would increase to 418 acres or 16 percent of the lease area.

One 50 acre agri-industrial park adjacent to one 50 MW powerplant (TABLE 14) would increase surface disturbance to 163 acres or 6.4 percent of the lease site.

Off-site utilization of heated waste water would not appreciably increase surface disturbance on the lease site and could result in a slight reduction in on-site impacts. Pipelines, pumping plants and storage tanks would be constructed between the powerplants and agri-industrial parks. Proper siting of agri-industrial parks in relation to favorable reinjection points, such as near the peripheral portions of the geothermal reservoir, could lessen waste-water disposal problems and could help extend the life of the geothermal field.

Nonelectrical Field Development

If exploration locates a geothermal reservoir with subsurface temperatures below 300^{o}F (150^{o}C), utilization of the resource for space heating and process heating rather than electrical energy may be practical. As with integrated electrical and nonelectrical development, the resource may be utilized on or off the lease site.

The number of wells necessary to supply hot water to an agri-industrial site or utility company is considerably lower than with a powerplant. Three producing wells and two injection wells are assumed in the development model.

The degree of surface disturbance expected with development of the resource for nonelectrical purposes is summarized in TABLE 16. Assuming a 100 acre agri-industrial site on the lease, 136 acres or 5.3% of the lease will be disturbed.

Utilization of geothermal energy off the lease site would require construction of a utility or agri-industrial site, pipelines, pumping plants and water storage facilities on mostly non-federal land. In addition, the two injection wells listed in TABLE 16 could be located at the utilization site. Resulting surface disturbance on the lease site would be considerably reduced. On the other hand, a 25-30 mile long pipeline to the City of Susanville could cause considerable surface disturbance.

TABLE 16

SURFACE DISTURBANCE EXPECTED TO RESULT FROM NONELECTRICAL DEVELOPMENT ON ONE 2560 ACRE LEASE

Feature	Number of Acres Disturbed	Number of Features	Acres Disturbed
Well (Producing,	2	3	6
injection)	2	2	4
Access Road	1.5	5	7.5
Mainline Road	12	1	12
Pipelines	1.2	5	6
Agri-industrial	100	1	100
TOTAL			135.5 or 5.3% of total lease area

Nonelectrical Model Development

To date, nonelectrical development has not taken place at either The Geysers or in the Imperial Valley, referring strictly to national resource lands. And neither area has considered nonelectrical development in the EAR. What is written below is a bit contradictory, yet it gives us an idea of the lack of data available at this point in time to

help define the geothermal potential for development in the Wendel-Amedee KGRA. The data leaves us without a clear-cut idea of whether development will be electrical, nonelectrical or both. That remains to be decided by the individual lessees.

A nonelectrical model for use by the specialists has been developed for several reasons. Exploratory work by the Bureau of Reclamation, "geological research to date, as well as the characteristics of known wells in the Susanville - Honey Lake Valley, would tend to indicate that the resource is likely to fall in the low to mid temperature ranges, i.e., 160°F - 300°F regime" (II-13) SGEP Proc.). Gulf Oil has drilled two deep exploratory wells in the Wendel-Amedee area. Near Wendel, Honey Lake No. 2 - ST was drilled 5,056 feet deep and the maximum interval temperature logged was 248°F. Near Amedee, Gulf drilled a deep hole to 5,029 feet. A bottom hole temperature of 230°F was recorded. (V-14, 15 SGEP Proc.)

According to California Division of Oil and Gas, Geothermal Unit, in the publication "The Potential of Low Temperature Geothermal Resources in Northern California", Report TR13, "Hot water geothermal systems are... divided into two temperature ranges: (1) those above 160°C (320°F) capable of being used to produce electrical power and (2) those from 50° - 160°C. Hot water systems above 160°C are economical for power production with present technology. If the thermal water is not hot enough to produce enough steam to be used directly or if surface and atmospheric pollution is a definite problem a binary cycle system may be practical. In this type of system, the heat is transferred to a low boiling point fluid, such as freon or isobutane, which expands and turns a turbine (Figure 5). At Paratunka, on the Kamchatka Peninsula, U.S.S.R., a freon-based generating unit is producing 0.7 MW (700KW) using 81°C (178°F) water."

Fluid temperatures less than 300°F would suggest utilization of the hot fluid in nonelectrical systems. Data recently received from the USGS, Menlo Park, for use in the Wendel-Amedee EAR states that "Based on available data and demonstrated technology, the geothermal resource at Wendel-Amedee is inadequate for electrical power generation. Additional information derived from on-going and proposed investigations in the area may very well demonstrate the presence of a more significant resource than is indicated with present data. The presently identified resource could be very beneficial applied to nonelectrical uses." (Page 16, 22, USGS Input to Wendel-Amedee EAR, 1976).

Because of known surface and subsurface geothermal temperature at Wendel and Amedee and interest shown by the City of Susanville in both electrical and nonelectrical utilization of the thermal fluids, a model has been developed for EAR analysis by each resource specialist.

The model matrix is the same as the electrical model, except nonelectrical production has replaced electrical production. The three candidate activities to be analysed were taken from the Susanville Geothermal

FIGURE 5 Binary System - 10 KW Unit at Wendel Hot Springs

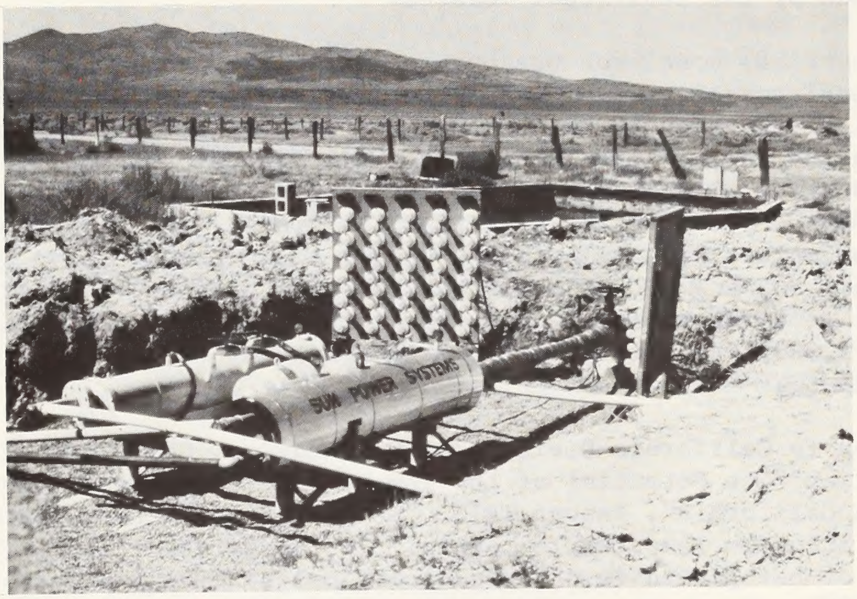


FIGURE 6 Wendel Hot Springs - Greenhouses

Energy Project Workshop Proceedings, held July 14-16, 1976 at Lassen College. On page III-3 in the proceedings, an energy cascade lists 15 activities, 14 of which are nonelectrical applications. Four nonelectrical activities were "tested for both inputs of energy and selected other production factors, and also for outputs." The four candidate activities were: hign energy food processing, two greenhouse activities, and single-cell protein (SCP) production. Of these four candidate activities, it was felt three might actually be implemented on natural resource lands. Specialists will consider the impacts expected to occur as a result of nonelectrical development on the lease sites only. If Federal leasing is approved and a specific proposal is made for off-site utilization, an environmental analysis of the transportation, utilization points and methods of usage would be necessary before approval is granted.

The three candidate activities are greenhouses, single cell protein (SCP) production and food product processing (Figure 6). SGEP used 7 acres as their basic greenhouse growing unit, 5 acres of greenhouses and 2 acres for support service units. According to the SGEP proceedings, "Greenhouse economics is strongly affected by size of development. The practical impact on the candidate greenhouse activity is that for a 5 acre (217,800 sq. ft.) unit, the investment is determined to be about \$3.75 per sq. ft. as compared to about \$6.98 for a 10,000 sq. ft. unit." (III-4, Workshop Proc.): For comparison, the hydroponic units at Wendel Hot Springs cover about 26,000 sq. ft. and North State Growers units on the south edge of Susanville cover about 28,000 sq. ft. Because greenhouses are capable of using temperatures at the lower end of the thermal scale, the probability of this activity predominating is very strong.

The following table provides some of the relevant scale criteria and scope for the basic greenhouse growing unit.

TABLE 17

BASIC GREENHOUSE GROWING UNIT - TOMATO PRODUCTIONS

Explanation

Minimum Size - Basic Unit		5 Acres
	Service Unit	2 Acres
Production Norms - Per Acre - Tomatoes		300,000 lb.
	Per Unit	1,500,000 lb.
Labor Requirements - Per Acre		3 Man Years
	Per Unit	15 Man Years

From TABLE 17 it is indicated that the greenhouse unit is fairly labor intensive. Based on the labor requirements per acre in TABLE 20, a labor force of 45 people would be required for three greenhouses in the 100 acre agri-industrial site.

The second candidate activity is single cell protein production. Single cell protein production has many advantages which are discussed at length by Dr. Barmettler in his article on Geothermal Energy Utilization, the most obvious being the savings in acreage, water consumption and expenditures necessary to produce 1,000 pounds of protein when compared with other more conventional protein sources--wheat, corn, soybeans and alfalfa. The fact is, among all of the important feed and food crops tested (TABLE 18), algae stands out as the least costly to produce.

TABLE 18

LAND AND WATER USED BY SELECTED CROPS
TO PRODUCE 1,000 LB PROTEIN ESTIMATES

CROPS	LAND AND WATER ESTIMATE		PRODUCTION AND COSTS	
	Sq. Ft. Land	Ac. Ft. Water	Lbs. Protein	Costs
Wheat	175,000	12.00	1,000	810.00
Corn	172,000	11.50	1,000	800.00
Soybeans	95,000	6.50	1,000	550.00
Alfalfa	30,000	2.75	1,000	240.00
Algae	2,100	0.20	1,000	200.00

Source: III-8, SGEP Proc.

Single cell protein algae material is processed as either animal (i.e., cattle) feed supplementation or as a useful food additive for human consumption. SGEP assumed that the initial model would be 20 acres in size. Open-air culture ponds would require 10 acres. Pumping facilities, aeration systems, centrifugal separators, nutrient injections, air-gas control system and other support facilities would occupy 10 acres.

Based on estimated labor requirements, 10 acres of S.C.P. production will require seven people. The model agri-industrial site assumes three S.C.P production plants may develop. This would require 21 employees for 30 acres of ponds and 30 acres of support facilities.

The third candidate activity is food product processing. Food product processing considers products that have considerable diversity and could be transported considerable distances to the energy site. Food product processing includes such activities as fruit juice concentration, vegetable juice concentration, fruit oil concentration and fruit and vegetable dehydration. Included are potatoes, onions, garlic, rice, etc. It has been assumed by SGEP personnel that the supply of onions, for example, could be contract grown by producers as much as 500 miles distant. In obtaining model acreages for this candidate activity, several food processing factories were contacted by telephone (TABLE 19). The model used by SGEP assumed a system capable of drying 115T/day (230,000 pounds) of green onions. The normal processing season for onion drying is between 150-180 days (5-6 months).

TABLE 19

COMPARISON OF CANDIDATE ACTIVITY
WITH OTHER SIMILAR ACTIVITIES

COMPANY	SEASON	WET MATERIAL	PROCESSING PLANT AREA
Vitapak Citrus Production (oranges, lemons)	120-150 days	125T/day	4-5 ac. (est.)
Gilroy Foods Inc. (onion dehydration)	120-150 days	115T/day	5 ac.
Sunkist (oranges, lemons)	365 days	110,000 to 450,000T/season	23 ac.
		* 169T/day	5 ac.

* (The figures for a 5-acre plant are an average reduced from a daily average of 777T/day for 23 acres.)

The figures for Gilroy Foods Inc. were obtained from the Company Field Manager in Gilroy. Given the assumptions of 115T/day and the 4-5 month season, he estimated that plant facilities would cover about 5 acres. Five acres will be used as the model size for analysis by each resource specialist. Based on Gilroy Foods' average production, approximately 10 people per eight hour shift are needed for a one dryer plant (115T/day). For three shifts, 30 employees would be needed.

A 100 acre agri-industrial site on each lease unit is assumed. Using the acreages and employee figures given for each candidate activity, we could have approximately 156 employees at a 96 acre agri-industrial site (TABLE 20).

TABLE 20

CANDIDATE ACTIVITIES FOR A 100 ACRE AGRI-INDUSTRIAL SITE

Activity	Number of Facilities	Acres per Activity	Total Acreage	Employees Per Facility	Total Employees
Greenhouses	3	7	21	15	45
SCP Production	3	20	60	7	21
Food Product Processing	3	5	15	30	90
TOTAL			96		156

We will assume that these activities will cover 100 acres for maximum development by each resource specialist.

6. Closedown Stage

This stage consists essentially of site abandonment and will occur when the geothermal resource is depleted. Geothermal steam reservoir knowledge has not advanced to a stage where a reasonable economic limit can be predicted, but for planning purposes, 30-50 years is assumed, which is merely the steam plant amortization period. The Lardarello field has been in production since 1904 and the Geyers since 1958. The Geysers is estimated to have a minimum productive life of 30 or more years. In a sense, however, geothermal reservoirs may be somewhat renewable resources in that, after a long period of rest, the fluids may become reheated to temperatures that are again usable.

Discrete operations during the closeout stage include the removal of all surface facilities, abandonment and capping of wells, and surface rehabilitation. Remaining solid waste may either be disposed of in a dump developed at the site or transported to the nearest established dump. In addition, any electrical transmission lines no longer in use will be dismantled and removed.

During the abandonment and capping of wells, the bottom of the hole would be plugged with cement and the surface casing would also be plugged with about 20 feet of cement. The casing would be cut off below the surface and a steel plate welded over the hole. A vertical steel pipe and marker would be welded to the plate and the location may be graded and revegetated. The marker will remain above ground to provide identification.

Surface rehabilitation will typically be a gradual process, taking place throughout the life of the field and culminating with final abandonment. Access roads can be ripped up, landscaped and revegetated, and powerline right-of-ways can be landscaped and revegetated. Well and plant sites can be similarly treated. Because of the relatively large size of these sites, complete landscaping to approximate the original surface in steep terrain would not be feasible except in unusual circumstances. The following are types of rehabilitation that could be applied during different stages of development.

1. Off-road vehicular travel. Generally no rehabilitation is undertaken because the disturbance is temporary and, in most areas, heals itself in a short time.

2. Road development. Roads needed for maintenance and further development will not be rehabilitated. Temporary roads and trails can be scarified and revegetated, if desirable.

3. Drilling. Small drill hole sites (seismic test holes, temperature gradient holes, informational holes) are usually rehabilitated by cleaning up any debris and smoothing the area with a bulldozer where needed. Mud pits are filled and leveled. Where climate and terrain permit, revegetation could be accomplished.

Large exploratory wells are capped with a pressure head ("Christmas tree") to prevent blow-outs, and typically left in operating condition. Other structures are removed and the drilling pad may be revegetated if climate permits.

4. Drill site development. After well completion, an area approximately 30 ft. x 30 ft. directly surrounding the well head will be needed for operation. An additional graded area about 50 x 100 feet may be needed for moving in a drilling rig to correct any problems which may develop during production. The reserve pit (sump) is generally dried out, covered with dirt and graded. It and the remaining area of the drill site can be rehabilitated and revegetated.

5. Plant construction. The area disturbed in constructing the generating plant and cooling towers can be rehabilitated and revegetated. The buildings may be painted to blend with the surroundings. Some cooling towers are architecturally attractive and, if desired, may be intentionally painted to contrast with the surroundings to heighten the visual experience.

6. Geothermal pipelines. Geothermal pipelines may be painted to blend with the surroundings and any areas not needed for access may be revegetated. At Lardarello, Italy, steam lines cross grainfields and vineyards with essentially no loss of land productivity.

7. Transmission lines. Surface disturbance accompanying electrical transmission line construction may be rehabilitated with the exception of needed maintenance roads.

surface rehabilitation will not alleviate geological processes, causing piles throughout the area of cut (fill) and grinding, or other [illegible] disturbance. Access roads can be closed off, [illegible], revegetated, and a [illegible] [illegible] can be introduced and revegetation. Cuts and drain sites may be similarly treated. Because of the relatively large size of these sites, complete [illegible] to the natural original surface [illegible] would not be feasible except in unusual circumstances. The following are types of rehabilitation that could be applied during different stages of development.

1. Off-road vehicular travel. Treatment or rehabilitation is unnecessary because it [illegible] is temporary and, in most cases, would disappear in a short time.

2. Road development. Roads needed for maintenance and further development will not be rehabilitated. Temporary roads and trails can be scarified and revegetated, if desirable.

3. Drilling. Small drill pads [illegible] [illegible] and [illegible] [illegible] holes, [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] cleaning up any debris and smoothing the area with a bulldozer where needed. Mud pits are filled and leveled. Where [illegible] and [illegible] permit, revegetation could be accomplished.

[illegible] [illegible].

4. [illegible]. The [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], covered with dirt and graded. It [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible] [illegible].

5. [illegible].

6. [illegible] [illegible] pipelines. [illegible].

7. Transmission lines. [illegible] [illegible] [illegible] [illegible] [illegible] [illegible], this construction may be rehabilitated with the exception of [illegible] [illegible] roads.

II. DESCRIPTION OF EXISTING ENVIRONMENT

A. Non-Living Components

1. Geology

Regional Geology

The Wendel-Amedee and Island study areas are situated in the Honey Lake Valley, in the Basin and Range physiographic province (MAP 8). Honey Lake Valley is a northwest-southeast trending topographic feature bound to the north by the Amedee, Shaffer and Skedaddle Mountains, and to the south by the Diamond Mountains. The Fort Sage Mountains are located at the southeast terminus of the valley.

The Honey Lake Valley is situated in a graben, bound by the Litchfield and Honey Lake Faults to the northeast and southwest. The central part of the valley is occupied by Honey Lake (intermittently dry) which covers an area of approximately 194 square kilometers (75 square miles). The lake bed is at an elevation of 1,219 meters (4,000 feet).

The Shaffer, Amedee and Skedaddle Mountains consist predominantly of Recent and Pleistocene andesite and basalt. The Diamond and Fort Sage Mountains are predominantly Mesozoic granite and Recent volcanics. Peak elevations range from 1,463 to 2,377 meters (4,800 to 7,800 feet)

The slopes of these mountains are covered by Recent and Recent-Pleistocene alluvium and colluvium. The basement rock in the valley consists of pre-Tertiary igneous and metamorphic rocks similar to those exposed in the Diamond and Fort Sage Mountains.

Local Geology

The rock units exposed within the study area are a series of Pliocene andesite flows and layered pyroclastic rocks (MAP 9). These rocks comprise the main mass of the Skedaddle and Amedee Mountains, and are flanked by basalt flows along the edges of the mountains. A depression between the ranges is the eroded center of a Pliocene volcano in which perlitic rhyolite is exposed. Pleistocene basalts are exposed in the southeastern portion of the Wendel-Amedee area. The Island area consists predominantly of lacustrine alluvium (recent lake deposits). The floor of Honey Lake Valley is a flat-lying sequence of Pleistocene to Recent lacustrine, aeolian sand and alluvial fan sediments spreading westward from the mountain front.

Long lines of calcareous tufa deposits on the northeastern shore of Honey Lake lead back toward the Skedaddle Mountains from both Wendel and Amedee Hot Springs. The tufa deposits mark positions of extinct hot springs and the traces of two faults.

The Litchfield Fault, the Amedee Fault and the Honey Lake Fault Zone are the major structures transecting the study area. The Litchfield Fault trends west northwest-east southeast and runs along the base of the Amedee, Skedaddle and Shaffer Mountains while the Amedee Fault trends north-south, cuts through the Skedaddle Mountains and closely borders the eastern shore of Honey Lake. The Honey Lake Fault Zone consists of a series of several faults trending approximately northwest-southeast along the base of the Diamond Mountains and bordering the southwest shore of Honey Lake.

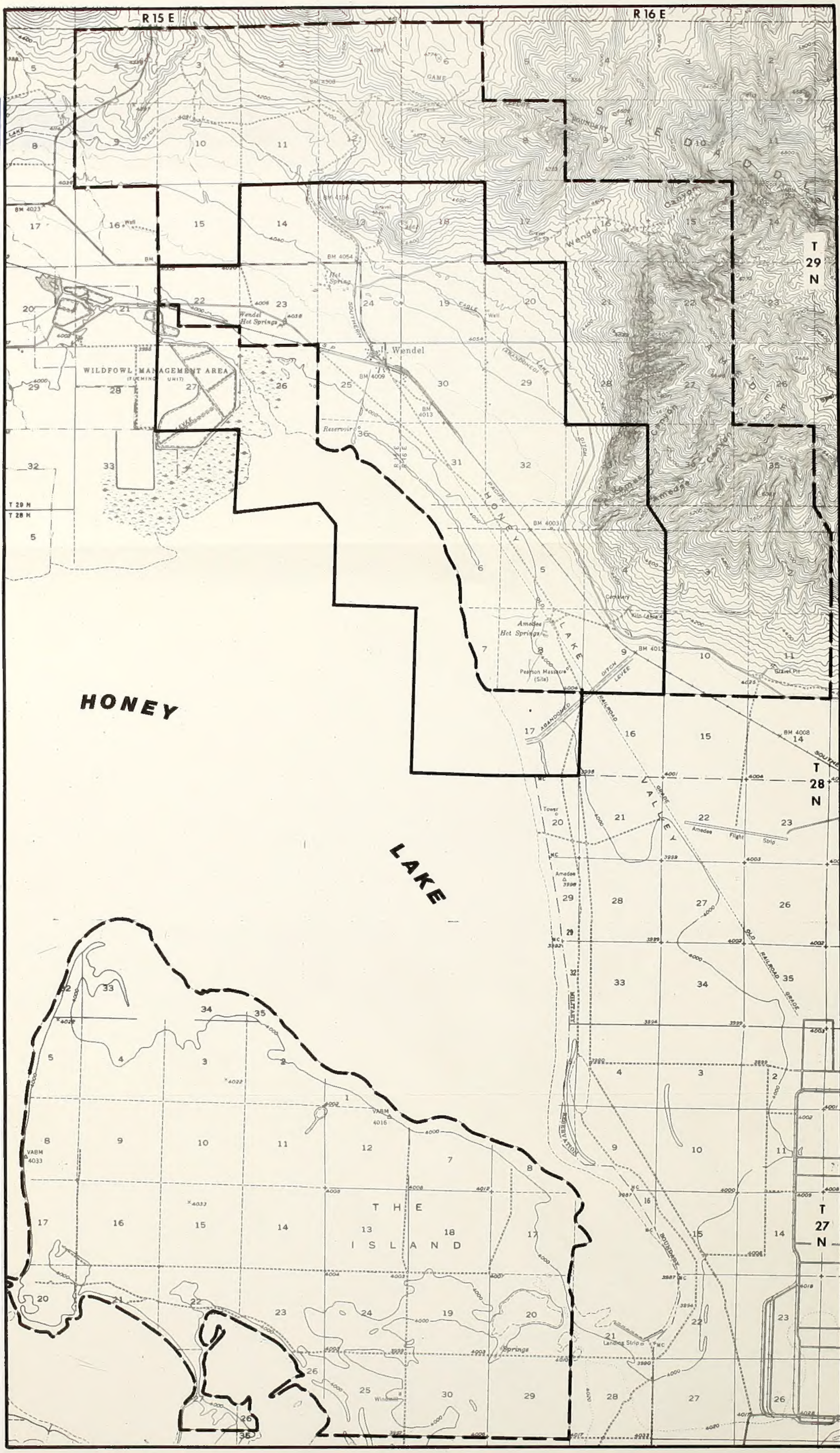
MAP 9 is a geologic map of the study area. It represents the spatial relationships of the rock types and structures.

Surface expressions of geothermal activity are present in the form of hot springs near Wendel and Amedee. Several test wells have been drilled in these same areas (TABLE 21). The only use to date for some of these wells and springs has been space heating at the Latter Day Saints Church, hydroponics at Wendel Hot Springs, and heated water at Roosevelt Swimming Pool. Two wells drilled by Gulf Oil Company near Wendel and Amedee are apparently not in use.

Natural Geologic Hazards

a. Seismicity

The Wendel-Amedee and Island areas are situated in a region generally recognized as presently having a high incidence of seismic events. The recorded history of seismic activity in the area, however, is short, and as such is not necessarily a reliable indicator of the frequency or magnitude of earthquake-related events in the vicinity of the study area. In the 37-year period 1934-1971, there was a total of 26 distinct earthquakes recorded in California (data from Nevada not available) within an approximately 80 km (50 mile) radius of the study area. About one-half of these events were within a 40 km (25 mile) radius of the study area. These data are presented in TABLE 22. Eleven of the 12 seismic events which occurred with epicenters within a 40 km radius of the study area were located on the west side of the Fort Sage Mountains in T. 26N., R. 17E. The epicenter of the other seismic event that occurred within a 40 km radius of the study area was located in the Amedee Mountains, east of the Wendel-Amedee area, apparently on one of the northwest-southeast trending faults in the Pliocene basalt (T. 29N., R. 17E.).



LEGEND

— — Study Area Boundary

——— Wendel-Amedee KGRA Boundary

MAP-8

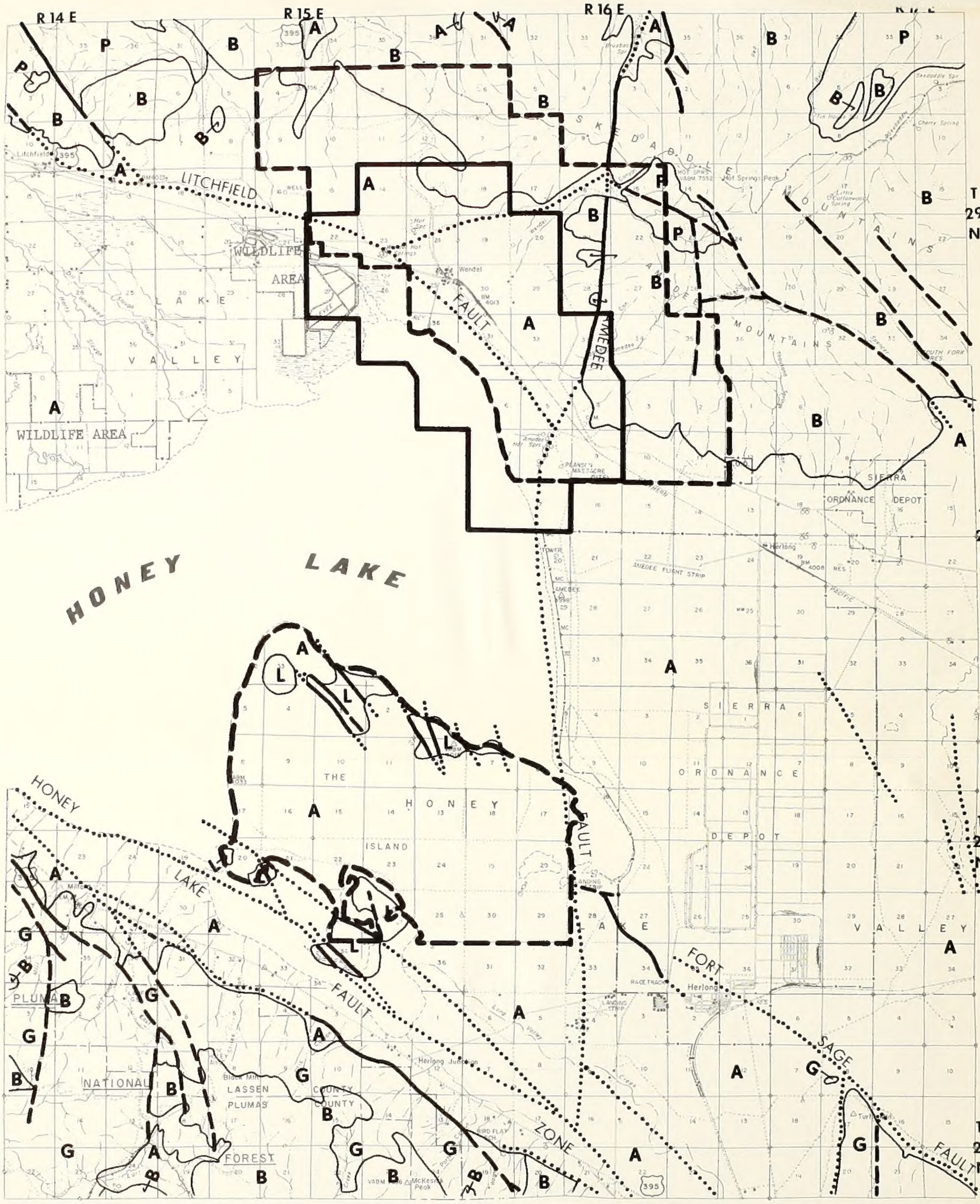
Contour Interval 40 Feet

SCALE: 1" = 1 MILE

MT. DIABLO MERIDIAN

HONEY LAKE VALLEY GEOTHERMAL STUDY AREA

TOPOGRAPHY



LEGEND

- Study Area Boundary
- Fault Trace
- Concealed Fault Trace

A	Quaternary Alluvial— Lake and near shore deposits
B	Quaternary/Tertiary Basalt
P	Quaternary/Tertiary Pyroclastic Rocks
L	Tertiary Lake Deposits
G	Mesozoic Granitic Rocks

SOURCE:
Northeastern Counties Groundwater Investigation,
California Department of Water Resources,
Bulletin 98, Volume II, 1963

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

GEOLOGY

MAP-9

SCALE: ½" = 1 MILE MT. DIABLO MERIDIAN

TABLE 21

SUMMARY OF GEOTHERMAL RESOURCES DATA IN WENDEL-AMEDEE AREA

Well number or spring name	Date of water sample	Temperature (^oC.)	SiO_2 (mg/l)	Estimated Reservoir temperature (^oC.)	Cold Water fraction (percent)
Amedee Spring (28N/16E, Sec. 8-NWNE)	1909	96	94	153	42
	1971	97	96	156	41
28N/17E-20J1*	1956	27	39	112	83
Roosevelt Swimming* Pool (29N/12E, Sec. 6-NENE)	1974	39	59	165	81
Latter Day Saints* Church well (29N/12E, Sec. 6-SENE)	1973	49	62	155	74
29N/15E-16G1	1958	27	54	193	91
Wendel Spring (29N/15E, Sec. 23-SWSE)	1971	97	117	183	50
29N/15E-24F1	1958	31	40	255	92
Southern Pacific RR (29N/16E, Sec. 30-NESW	1958	24	41	120	87
	1973	28	42	120	83
30N/12E-33N1*	1958	17	45	208	96
30N/12E-31R1*	1958	26	76	122	86

TABLE 21 (Continued)

SUMMARY OF GEOTHERMAL RESOURCES DATA IN WENDEL-AMEDEE AREA

Well number or spring name	Date of water sample	Temperature (^{o}C.)	SiO_2 (mg/l)	Estimated Reservoir temperature (^{o}C.)	Cold Water fraction (percent)
Near town of Wendel (29N/15E, Sec. 23)	-	64	-	-	-
Gulf Oil and well 29N/15E, Sec. 25	-	120	-	-	-
Near Amedee 29N/16E, Sec. 4, 8 3 wells - abandoned	-	107(max.)	-	-	-
Gulf Oil well 28N/16E, Sec. 5	-	110	-	-	-

1. From Hardt et. al., 1975

2. From Reed, 1975

* Location not in or immediately adjacent to study area.

The earliest documented seismic event in the vicinity of the study area occurred "A few years before 1885 (sic) ..." and consisted of " ... a number of small earthquakes ..." of undetermined magnitude (Diller, 1908). The epicenter was apparently located in the vicinity of Janesville along the Honey Lake Fault Zone.

The majority of recorded seismic events in the vicinity of the study area have been of relatively low magnitude, and as such may be characterized as microearthquakes associated with geothermal areas (Ward, 1972). The magnitudes of microearthquakes are generally from 2 to 4 on the Richter scale and occur as swarms. The epicenters of the events are generally shallow, less than one or two kilometers in depth, and appear to be associated with normal or strike-slip faults.

Ward (1972) has observed that earthquakes with magnitudes greater than about 4.1 seem to be very rare in the crust under geothermal areas, even though most geothermal areas occur near major seismic belts.

The characterization of these swarms of low magnitude earthquakes in the area as microearthquakes associated with geothermal acitivity has been treated with some reservation, however, in that similar events have been recognized in northern Nevada in areas not identified with geothermal activity (Van Wormer, 1976).

It has been proposed that the best criterion for defining and identifying seismic hazards for a given area is the record of seismicity as preserved in the Holocene record as fault-associated land forms (Allen, 1974). In the Honey Lake area, however, only the very major land forms produced by faulting have been preserved. Generally, the stratigraphic-structural relationships in the area have not been defined with sufficient clarity or detail to determine the relative times of displacement of the faults. The Litchfield Fault evidently has had post Plio-Pleistocene displacement and, as previously stated, the Honey Lake Fault Zone likely experienced movement in the historic past. In the recent record most of the earthquakes occurring in the area have been in the Fort Sage Mountains, which lie some six miles south and east of the Island study area.

The only well-documented occurrence of surface expression, i.e., faulting, associated with this seismic activity (event of December 14, 1950) is on the west side of the Fort Sage Mountains (Gianella, 1957). Here a small displacement over a distance of 5.5 miles was identified. The fault extends from about 1.25 miles northeast of Doyle, northward, to curve around the northern base of Turtle Mountain. The fault scarps are in T. 25 and 26N., R. 17E., and consist of two segments of about equal length. The southern segment terminates in the southern part of Section 29, and the northern segment begins about 0.25 mile to the west and continues to the north end of Turtle Mountain. The maximum observable displacement does not exceed five inches anywhere along the northern segment. These are normal faults with the downthrown block to the west. In places, disturbance of the sediment indicates a displacement of the underlying rock of up to two feet.

b. Liquefaction

Ground failure due to liquefaction is a potential hazard in the study areas. Liquefaction is defined as the transformation of a granular material (sediment) from a solid state to a liquefied state as a consequence of increased pore fluid pressure. This potential hazard is identified in the study areas because of three existing conditions: (1) a thick sedimentary sequence; (2) high water-table providing saturation; (3) shock waves resulting from seismic activity.

Test drilling in the Island area indicates that the sedimentary sequence is at least 1,210 meters (4,000 feet) thick, and consists predominantly of shale and minor sand horizons with lenses of low permeability (Reade, 1965). These sediments likely act as a barrier to ground-water movement, and are probably too dense for pore water pressures to significantly increase during cyclic loading (i.e., seismically induced shock waves), thereby reducing the probability of liquefaction occurring except possibly in small localized sand lenses.

Prior seismic history of an area has also been shown to play a significant role in modifying the liquefaction potential of sediments. Repeated small to moderate shocks such as those tabulated in TABLE 22 may increase the resistance of sediments to liquefaction as much as 46 percent relative to sediments with the same densities and no prior seismic history (Seed, Arago and Chan, 1975). Consequently, the overall potential for ground failure due to liquefaction is not considered high in the study areas.

c. Slope Stability

With the exception of the northeast part of the Wendel-Amedee area, the relative relief of the study areas is low. Slopes in the northwest part of the Wendel-Amedee area range from approximately 4 to 8½ degrees. Surface materials on these slopes consist of basalt, talus, and alluvium. The unconsolidated material may be unstable, but landslides are not known to occur frequently in the area.

2. Soils

The entire geothermal area has been surveyed by the Nevada Department of Conservation and Natural Resources, The Resources Agency of California, the United States Department of Agriculture, Forest Service and the Soil Conservation Service.

The soil characteristics and properties are shown in detail in Appendix 4 and on MAP 10 by symbol number. The acreages presented here only apply to natural resource lands.

The soils information, as developed for use in this report, are suited only for general planning. Detailed operational plans would require on-the-ground field investigations.

TABLE 22

CALIFORNIA EARTHQUAKE EPICENTERS (1934-1971)

WITHIN 25-MILE RADIUS OF CENTER OF STUDY AREA

LATITUDE DEG.	LATITUDE MIN.	LONGITUDE DEG.	LONGITUDE MIN.	DATE	MAGNITUDE
40	05	120	04	12-11-50	4.1
40	05	120	04	12-14-50	4.0
40	05	120	04	12-14-50	4.0
40	05	120	04	12-14-50	4.0
40	05	120	04	12-14-50	5.6
40	05	120	04	12-14-50	4.1
40	05	120	04	12-15-50	4.4
40	05	120	04	12-17-50	4.0
40	05	120	04	10-26-52	4.3
40	06	120	04	12-14-50	5.0
40	06	120	04	12-14-50	4.8
40	18	120	04	09-27-47	4.4

ADDITIONAL EPICENTERS

WITHIN 50-MILE RADIUS OF CENTER OF STUDY AREA

LATITUDE DEG.	LATITUDE MIN.	LONGITUDE DEG.	LONGITUDE MIN.	DATE	MAGNITUDE
39	33	120	05	12-29-48	6.0
39	33	120	05	01-08-49	4.3
39	34	120	18	10-01-58	4.6
39	36	120	18	05-10-47	4.2
39	36	120	28	11-18-60	4.4
39	40	120	33	06-14-59	4.5
39	42	120	06	10-30-59	4.1
39	42	120	24	06-22-34	4.1
39	43	120	12	04-01-59	5.6
39	48	121	48	05-24-66	4.6
40	00	121	00	06-06-34	4.5
39	24	121	06	09-12-66	6.0
40	00	121	00	05-01-41	4.5
40	04	120	42	02-19-51	4.2

Source Data: California Department of Water Resources, Bull. 116-Z Toppozada, 1975.

The soils in the Wendel-Amedee and Island areas are predominantly basin shore lines. They all contain alkali, are relatively flat and have a moderate soil permeability rate. As a result surface run-off is not common.

The Skedaddle Mountain area on the northeast side of Wendel-Amedee area has steep, rocky drainages that carry heavy surface run-off into the foot hills that have soils that have a rapid permeability to effectively absorb waters into the underground aquifers.

As a result the soils numbered 419, 4063 and 4064 are delineated as a rechange area on MAP 12.

Mapping Symbol

419. These soils are characterized by a mixture of sandy-fine loams that are characteristic of shorelines, terraces, alluvial fans and dunes. They may have Big sage, desert shrub and saltgrass vegetative cover. They all have rapid permeability, slope 0-15 percent and deep soils 60 inches plus. Within the 60 inches of soil there is 5-15 percent stoneyness on the surface and 10-65 percent stoneyness in the subsurface.

These soils are very susceptible to accelerated soil erosion because of their particular characteristics and location along the sloping foot hills.

Revegetation is possible even though the soils vary from slightly acid to strongly alkaline.

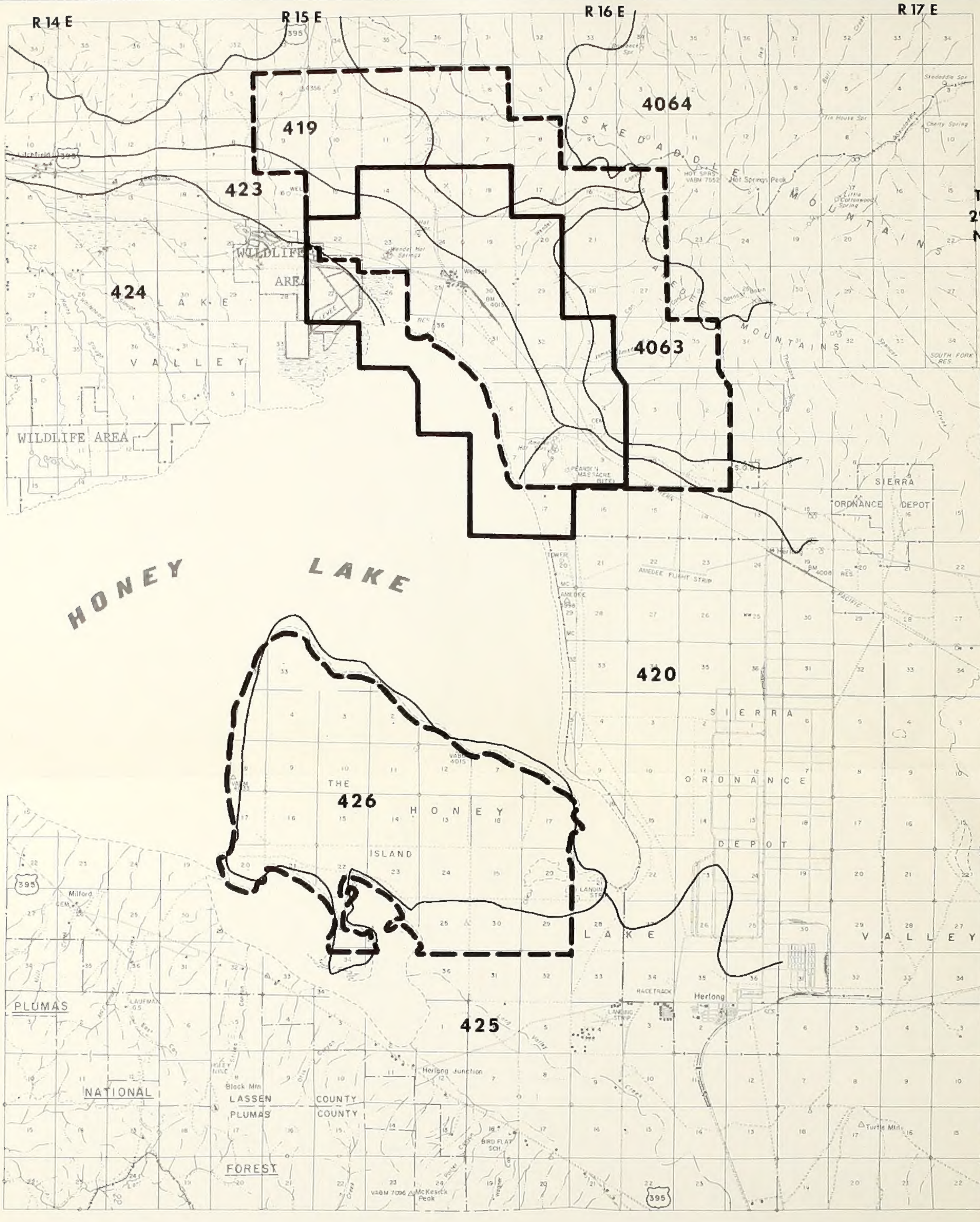
420. These soils are characterized by fine sands and loams that were deposited as basin and lake terraces and some alluvial fans. They may have desert shrub and shadscale cover which indicates their mildly to strongly alkaline conditions. Slope is from 0-15 percent, nearly flat and they have moderate permeability.

Revegetation is difficult at best, because soil alkalinity will limit their success.

423. These soil associations are nearly identical to the previous soils (420). The only real different characteristic is its alkalinity. 420 is mildly to strongly alkaline and 423 is strongly to very strongly alkaline.

Revegetation is difficult at best and may be impossible in some local areas.

424. This soil grouping is characterized by mixed loams, heavy clays (montmorilleonitic) and mild to strongly alkaline conditions. The primary soil forming district in Honey Lake Valley is situated on these soils. This soil grouping is adjacent to the Wendel-Amedee study area but not within it.



LEGEND

Study Area Boundary

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA
SOIL ASSOCIATIONS

MAP-10

SCALE: ½" = 1 MILE   MT. DIABLO MERIDIAN

425. These soils are characterized by a deep (60") coarse-loamy structure which has a moderate to rapid permeability. The vegetative cover is big sage and greasewood. This soil is neutral to strongly alkaline. Slope is 0-5 percent, nearly flat and it has a great capability to produce vegetation if it only had water. Revegetation should be easy in most areas.

426. These soils are characterized by mixed, fine-loamy, over sandy soils. They are lake terraces or basin soils deeper than 60 inches. They are presently covered with greasewood and shadscale which is evidenced by the strongly alkaline conditions. The slope is nearly flat (0-5 percent) and this soil has moderate permeability.

Revegetation is fair to poor.

4063. These soils are located on mountain ridges, ranging from 30-70 percent slope, very well drained and neutral in respect to soil alkalinity.

These soils have fine mixed clays and loams with stoneyness from 30-70 percent on the surface. Subsurface soils have 15-20 percent gravel. The soil permeability is slow to moderate and depths range from 15-30 inches.

This is a primary run-off and recharge area for ground water within the Wendel-Amedee study area.

The soils are covered with big sage and Juniper.

4064. These soils are similar to 4063 previously discussed. The only real difference is that the slope and rockyness increases. Rock outcrops are common.

Revegetation is possible.

3. Water

Overview

The average annual precipitation near Diamond Mountain is 12 inches and 6 inches or less in the geothermal study areas (Figure 7). Seven streams in the area empty into Honey Lake during the spring run-off season. Thus, approximately 194,000 acre-feet of water is contributed to Honey Lake yearly. However, during the farming season, all streams terminate before they reach Honey Lake--most of this surface water is utilized for irrigation purposes. Evaporation losses from Honey Lake are about 10,000-200,000 acre-feet of water per year.

Quantified Hydrologic Cycle

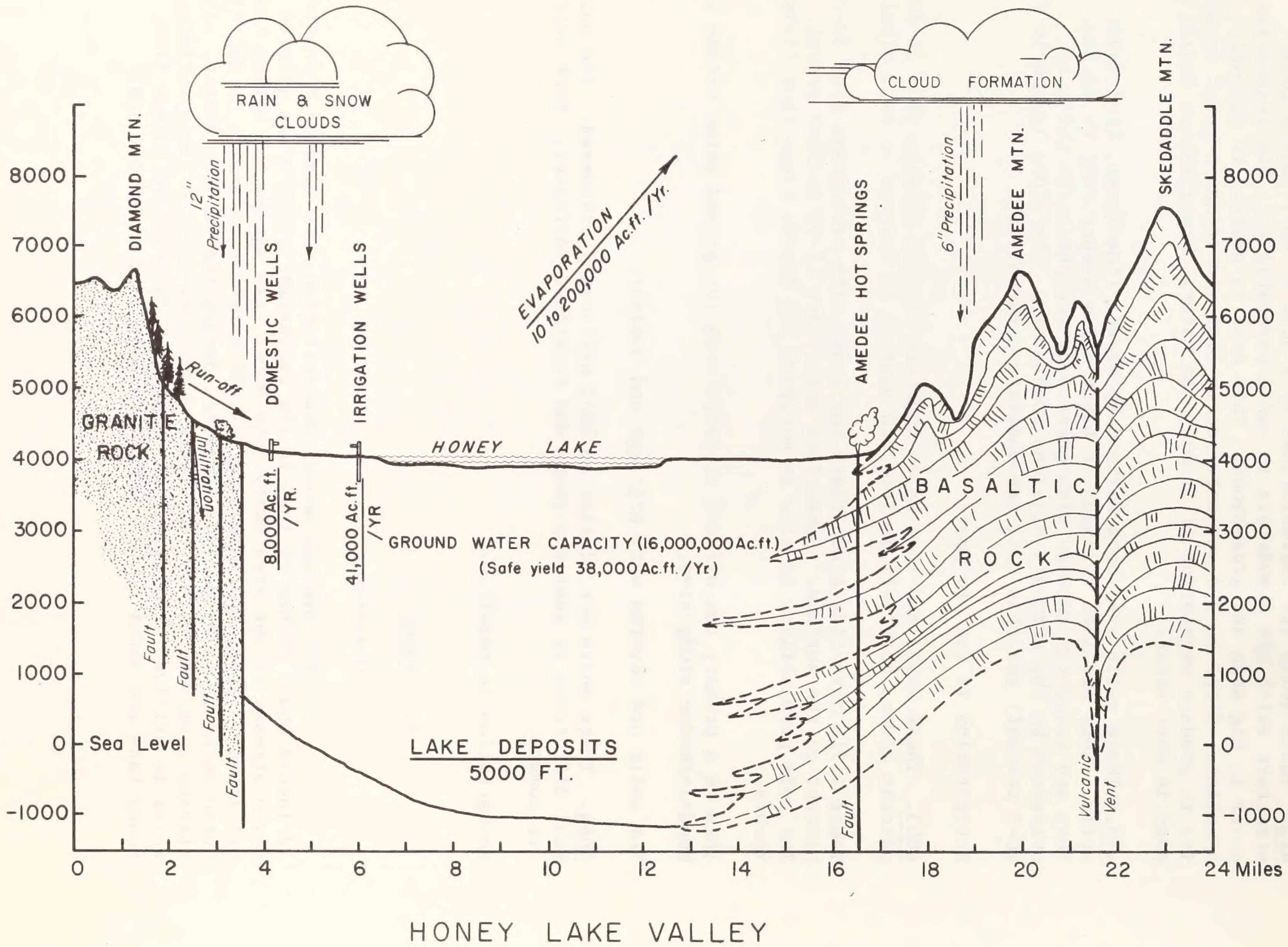


FIGURE 7

The ground water pool below Honey Lake is estimated at about 16,000,000 acre-feet. The annual recharge rate is approximately 38,000 acre-feet. Presently, this water source is used for both domestic and irrigation wells at a rate of about 49,000 acre-feet per year.

Surface Water

Honey Lake is the most readily apparent surface water body in the Honey Lake basin (MAP 11). During the Pleistocene epoch, Lake Lahontan covered all of Honey Lake Valley as well as adjacent areas of northwestern Nevada. Lake Lahontan had a maximum surface elevation of about 4,400 feet and a maximum depth of about 400 feet in the Honey Lake basin. The water surface of the lake probably fluctuated a great deal during the Pleistocene epoch. In fact, the lake may have dried up during the interglacial stages only to reappear during the succeeding glacial stages.

With the beginning of the recent epoch, the climate of the region gradually became more arid. Lake Lahontan slowly began to dry up until today only a few remnants are left, such as Honey Lake in California, and Pyramid and Walker Lakes in Nevada.

Presently Honey Lake covers 93 square miles and has an average depth of about 5 feet. The lake has dried up completely three times since 1900.

Seven streams are tributary to Honey Lake: Susan River, Long Valley Creek, Willow Creek, Shaffer Creek, Baxter Creek, Parker Creek, and Wendel Creek. TABLE 23 shows the type of each of these streams, origins and discharge, where known.

TABLE 23

TRIBUTARY STREAMS OF HONEY LAKE

Name	Terminal	Perennial	Origin inside	Origin outside	Ann. Total Ac. ft.
Susan River		X		X	59,700
Long Valley Cr.		X		X	15,681
Willow Cr.		X		X	15,600
Shaffer Cr.	X			X	–
Baxter Cr.	X			X	–
Parker Cr.	X			X	–
Wendel Cr.	X		X		–

Run-off from the Diamond Mountains, along the southwestern shores of Honey Lake between Susanville and Constantia, constitutes a substantial part of the inflow to Honey Lake. The Diamond Mountains watershed has an area of 130 square miles.

Gaging stations records for Mill Creek at Milford indicate that between 30,000 and 60,000 acre-feet of water per year flow into Honey Lake from these mountains, via the Susan River, in all but the driest years.

During the summer crop irrigation season (between June and October) only small quantities of waste water reach Honey Lake, which serves primarily as a settling basin for excessive salts leached from farm lands. However, the lake has value as a resting place for migrating waterfowl (see Wildlife section).

Wendel Creek in the Wendel-Amedee study area is the only stream within the entire study area. It is intermittent, and only under extreme high run-off conditions, such as a 25-50 year storm, will water reach Honey Lake via Wendel Creek. The creek's primary value is as drinking water for wildlife and domestic livestock. No data have been collected on the existing water quality or quantity of Wendel Creek.

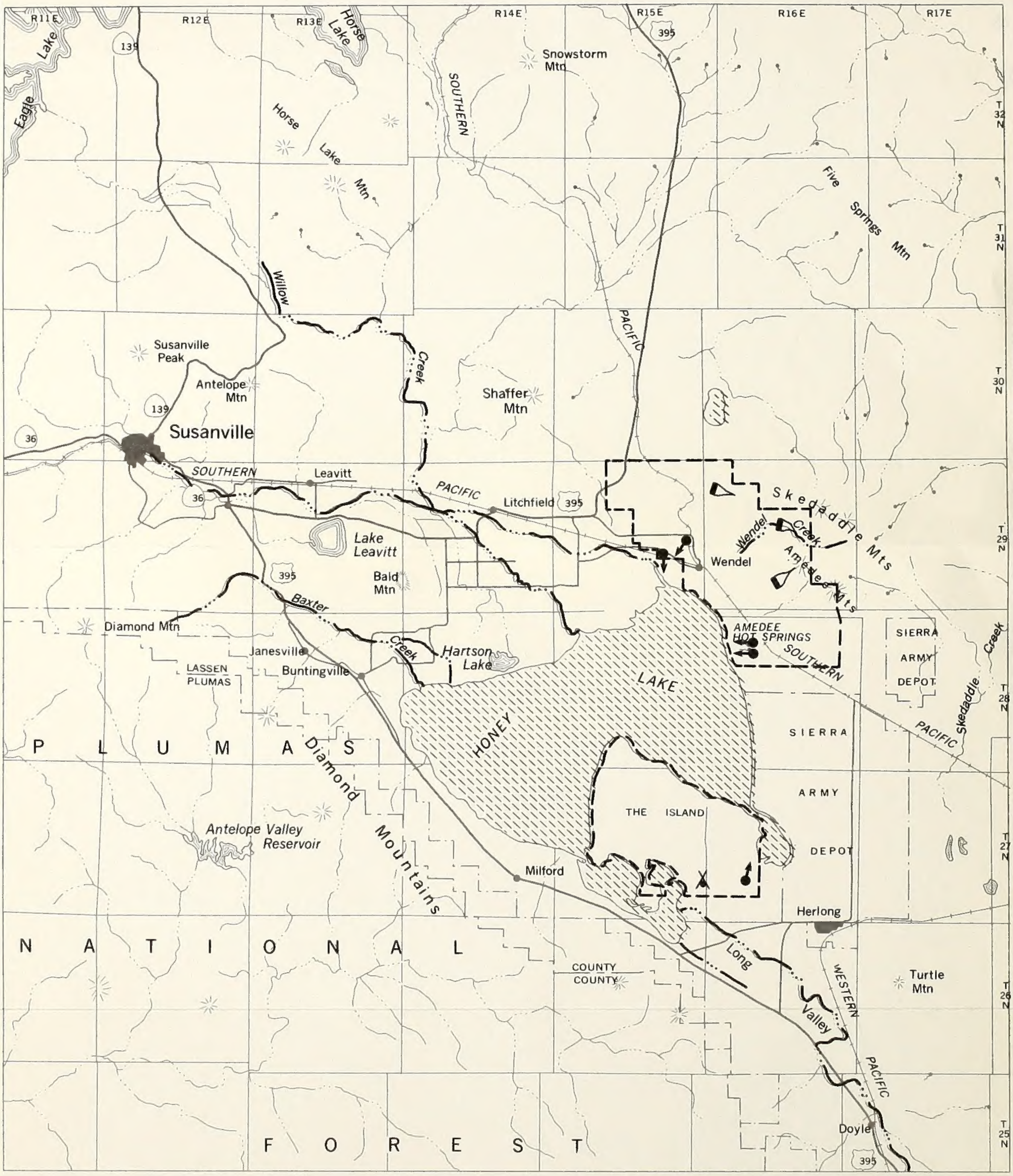
a. Surface-Water Quality

Water quality for the Susan River is shown on TABLE 24, and for Honey Lake in TABLE 25. The water in Honey Lake has such high sodium content (94 percent) that it has no value for domestic or irrigational use. Sodium content exceeding 15 percent renders water valueless for irrigation. The lake serves primarily as a settling basin for leached salts from surrounding farm lands.

Ground Water

Honey Lake Valley ground water basin is unique among the ground water basins of northeastern California in that most of the good recharge areas are those with a minimum of precipitation. Areas with higher precipitation are not recharge areas in most of the region adjacent to Honey Lake Valley. The overall ground water development potential of the valley floor is good, but not as good as it would be if precipitation were greater over the better recharge areas.

There are large areas immediately north of Honey Lake where the water table is less than 5 feet below the ground surface. Lowering of the water table in summer months and allowing it to recharge in periods of high run-off could increase the yield of ground water from this area. Presently the high water table prevents the infiltration of additional water into the ground water body.



LEGEND

Study Area Boundary
Water
Springs
Reservoirs
Windmill

MAP-11

MT. DIABLO MERIDIAN

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA
SURFACE WATER RESOURCES

TABLE 24

SURFACE WATER QUALITY

Susan River (Station 1590.01)

(concentration expressed as mg/l)

Location of Sampling Station	Sampling Date	T(°C)	pH	Ca	Mg	Na	K	CO_3	HCO_3	SO_4	Cl	NO_3	B	F	SiO_2	TOS	Discharge (cfs)
29/14-16B	10/16/73	13.0	8.1	-	-	-	-	-	-	-	-	-	-	-	-	-	37
29/14-16B	11/13/73	5.5	7.5	11	7.2	14	2.9	0	86	9.0	3.7	3.8	0	-	-	112	225
29/14-16B	12/05/73	.40	8.3	-	-	-	-	-	-	-	-	-	-	-	-	-	120
29/14-16B	01/15/74	4.	7.0	-	-	11	-	0	62	-	0.5	-	0.10	-	-	-	1090
29/14-16B	02/06/74	1.0	8.3	-	-	-	-	-	-	-	-	-	-	-	-	-	504
29/14-16B	03/13/74	7.0	7.8	-	-	-	-	-	-	-	-	-	-	-	-	-	334
29/14-16B	04/17/74	10.0	8.0	-	-	10	-	0	74	-	1.4	-	0.00	-	-	-	427
29/14-16B	05/09/74	13.0	7.4	-	-	6.6	-	0	48	-	0.5	-	0.00	-	-	-	838
29/14-26B	06/06/74	19.0	7.7	-	-	-	-	-	-	-	-	-	-	-	-	-	273
29/14-16B	07/17/74	29.0	8.3	-	-	-	-	-	-	-	-	-	-	-	-	-	103
29/14-16B	08/15/64	19.0	8.2	-	-	-	-	-	-	-	-	-	-	-	-	-	95
29/14-16B	09/11/74	20.0	8.4	-	-	-	-	-	-	-	-	-	-	-	-	-	24

TABLE 25

EXISTING SURFACE WATER QUALITY

HONEY LAKE

Parameter	Units	Value
pH	--	8.9
Na	mg/1	522
Na	%	94
Cl	mg/1	242
B	mg/1	2.8
TDS	mg/1	1,460
EC @ 25°C	umhos/cm	2,310
Hardness	mg/1 as $CaCO_3$	36
F	mg/1	2.8
NO_3 - N	mg/1 as N	0.8

Source: California State Water Resources Control Board, Water Quality Control Plan Report, 1975, pg. II-14-14.

a. Water-Bearing Formations

TABLE 26 briefly describes the geologic formations in Honey Lake Valley. Of these, the principal water-bearing formations are Pliocene lake deposits, Plio-Pleistocene and Pleistocene lava flows, Lahontan lake and near-shore deposits, and Recent valley sediments.

Pliocene Lake Deposits. Pliocene lake deposits, underlying nearly all of Honey Lake Valley and the lava fields found to the north, reach a maximum thickness of about 5,000 feet near the northwestern end of the Island. The deposits are usually covered by several hundred feet of Lahontan lake deposits and Recent valley sediments and thus are usually encountered only in deeper wells. In general, Pliocene lake deposits are of low permeability, but locally may yield moderate quantities of confined water to wells.

Plio-Pleistocene and Pleistocene Lava Flows. These lavas are moderately to highly permeable and, in the volcanic terrain north of the valley, they act as upland recharge areas. The lavas also serve as important confined aquifers in the northwestern and northeastern portions of Honey Lake Valley, where they yield large amounts of ground water to irrigation wells.

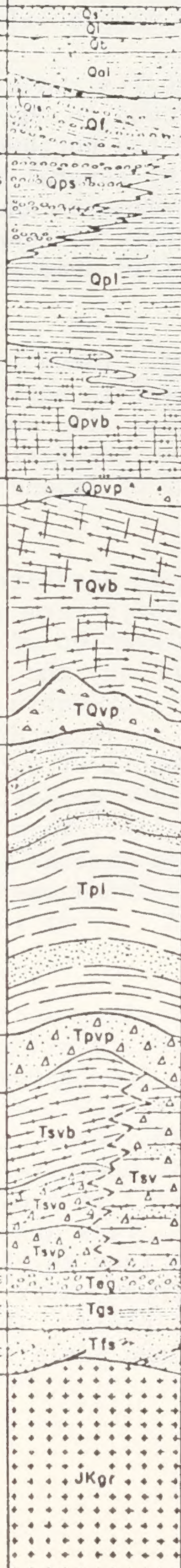
Lahontan Lake and Near-Shore Deposits. These deposits are up to 700 feet thick. Coarse-grained near-shore deposits form a discontinuous belt around the edge of the valley to an elevation of about 4,400 feet, and relatively fine-grained lake deposits occupy the central part of the valley. The near-shore deposits are highly permeable and frequently occur above the water table where they act as important recharge areas. Where saturated, they often yield large amounts of water to wells and sumps. Highly permeable sand beds in the lake deposits, northwest of Honey Lake and in and just north of Long Valley, form the most important aquifers in the valley as they provide large amounts of water to irrigation wells. In contrast, the lake deposits found east of Honey Lake and north of Herlong consist mainly of silt and clay of low permeability and are poor producers of ground water.

Recent Valley Sediments. Principal Recent valley sediments in Honey Lake Valley include basin deposits, intermediate alluvium, and alluvial fans. The basin deposits are thin, of very low permeability, and generally are a poor source of ground water. Intermediate alluvium occurs along most of the perennial streams where they enter the valley. The permeability of the intermediate alluvium is moderate, but it is usually less than 100 feet thick and yields only small to moderate amounts of ground water to shallow wells. The alluvial fans are of moderate to high permeability and may be as much as 300 feet thick. The fans yield large amounts of confined and unconfined ground water to irrigation wells, particularly in Long Valley south of Doyle. The landslides in Hidden Valley are of moderate permeability and yield moderate quantities of water to wells.

TABLE 26

GEOLOGIC FORMATIONS IN HONEY LAKE VALLEY

GEOLOGIC AGE				GEOLOGIC FORMATION	STRATIGRAPHY	APPROXIMATE THICKNESS IN FEET
CENOZOIC	QUATERNARY	RECENT		SAND DEPOSITS	Qs	0-25
CENOZOIC	QUATERNARY	RECENT		LAKE DEPOSITS	Ql	0-25
CENOZOIC	QUATERNARY	RECENT		BASIN DEPOSITS	Qb	0-50
CENOZOIC	QUATERNARY	RECENT		INTERMEDIATE ALLUVIUM	Qal	0-100
CENOZOIC	QUATERNARY	RECENT		LANDSLIDES	Qls	0-50
CENOZOIC	QUATERNARY	RECENT		ALLUVIAL FANS	Qf	0-300
CENOZOIC	QUATERNARY	PLEISTOCENE		NEAR-SHORE DEPOSITS	Qps	0-400
CENOZOIC	QUATERNARY	PLEISTOCENE		LAHONTAN LAKE DEPOSITS	Qpl	0-700
CENOZOIC	QUATERNARY	PLEISTOCENE	PLEISTOCENE VOLCANIC ROCKS	BASALT	Qpvb	50-500
CENOZOIC	QUATERNARY	PLEISTOCENE	PLEISTOCENE VOLCANIC ROCKS	PYROCLASTICS	Qpvp	0-200
CENOZOIC	QUATERNARY / TERTIARY	PLIO-PLEISTOCENE	PLIO-PLEISTOCENE VOLCANIC ROCKS	BASALT	TQvb	4000
CENOZOIC	TERTIARY	PLIO-PLEISTOCENE	PLIO-PLEISTOCENE VOLCANIC ROCKS	PYROCLASTIC ROCKS	TQvp	?
CENOZOIC	TERTIARY	PLIOCENE		PLIOCENE LAKE DEPOSITS	Tpl	0-5000
CENOZOIC	TERTIARY	PLIOCENE		PLIOCENE PYROCLASTIC ROCKS	Tpvp	1000
CENOZOIC	TERTIARY	PRE-PLIOCENE	SIERRAN VOLCANIC ROCKS	BASALT	Tsvb	2000
CENOZOIC	TERTIARY	PRE-PLIOCENE	SIERRAN VOLCANIC ROCKS	ANDESITE	Tsva, Tsv	
CENOZOIC	TERTIARY	PRE-PLIOCENE	SIERRAN VOLCANIC ROCKS	PYROCLASTIC ROCKS	Tsvp	
CENOZOIC	TERTIARY	PRE-PLIOCENE		AURIFEROUS GRAVELS	Tag	?
CENOZOIC	TERTIARY	PRE-PLIOCENE		GOLD RUN SANDSTONE	Tgs	?
CENOZOIC	TERTIARY	PRE-PLIOCENE		FORT SAGE SANDSTONE	Tfs	?
MESOZOIC	JURASSIC TO CRETACEOUS	BASEMENT COMPLEX		GRANITIC ROCKS	JKgr	?



PHYSICAL CHARACTERISTICS	WATER-BEARING CHARACTERISTICS
Qsd: Loose, wind-blown sand.	Highly permeable but located above water table, hence contains little water.
Ql: Unconsolidated silt and clay, contains alkali.	Very low permeability and of little importance to ground water.
Qb: Unconsolidated sand, silt, and clay. Often contains alkali.	Low permeability. May yield small amounts of water to domestic wells.
Qal: Unconsolidated sand, silt, and gravel with lenses of clay.	Moderate permeability. Yields small to moderate quantities of water to wells.
Qls: Unconsolidated mixtures of rock, sand, and clay.	Moderate permeability. May yield moderate quantities of water to wells in Hidden Valley.
Qf: Unconsolidated gravel, sand, and silt, with some clay lenses.	Moderate to high permeability. Yields large quantities of water to wells. May contain confined water.
Qps: Unconsolidated, poorly cemented, bedded gravel, sand, and silt.	Highly permeable. Frequently occurs above water table. Where saturated yields large quantities of water to wells and sumps.
Qpl: Poorly consolidated, bedded sand, silt, and clay.	Permeability ranges from low to high. Contains important aquifers in Honey Lake Valley. Often yields large quantities of water to wells.
Qpvb: Jointed basalt flows containing zones of scoria.	Moderate to high permeability. May yield large quantities of water to wells. Acts as forebay for ground water recharge.
Qpvp: Bedded mudflows and tuffs.	Low permeability, unimportant to ground water.
TQvb: Jointed, fractured flows of vesicular basalt with some pyroclastic rocks.	Moderate permeability, may yield moderate amounts of water to wells. May contain confined water. Important as forebay for ground water recharge.
TQvp: Pale-colored bedded tuff.	Unimportant to ground water.
Tpl: Bedded, consolidated sandstone, tuffaceous siltstone and diatomite.	Generally of low permeability. Locally may yield moderate quantities of water to wells. Contains confined water.
Tpvp: Massive, cemented tuff and mudflows.	Essentially impermeable.
Tsvb, Tsva, Tsvp, Tsv: Flows of fractured basalt, andesite, and minor amounts of other types of lava. Massive mudflows and tuffs.	Permeability ranges from poor to moderate. Basalt is generally above zone of saturation, is underlain by impermeable rock, and is unimportant to ground water. A few areas may contain perched ground water. Andesite and pyroclastic rocks are essentially impermeable.
Tag: Semi-consolidated gravel, sand, and clay.	Low to moderate permeability. Yields water to many springs. Not important to ground water in Honey Lake Valley.
Tgs: Semi-consolidated, poorly cemented sandstone and shale.	Low permeability. May yield small quantities of ground water to wells.
Tfs: Consolidated, cemented sandstone.	Essentially impermeable.
JKgr: Massive, poorly jointed diorite. Locally weathered and decomposed.	Impermeable where fresh. Decomposed rock may yield small quantities of water to wells and sumps.

b. Influence of Geologic Structure on Ground Water

For more detail on geologic characteristics of the Honey lake basin, see Geology section. Faulting and subsidence of Honey Lake Valley have had a pronounced effect on the Pliocene lake deposits thus undoubtedly affecting ground water movement. However, present data are insufficient to determine the detailed effects of these structural features. There appear to be no major fault barriers beneath the valley floor area. This may be because the Lahontan and younger sedimentary deposits probably have not been displaced by faulting.

Several faults in Honey Lake Valley act as conduits for the upward percolation of mineralized thermal waters. This water feeds Amedee and Wendel Hot Springs and several hot water wells in the southern part of Susanville.

The intense faulting along the Honey Lake fault zone has crushed the granitic rocks in many localities, thereby accelerating their weathering and decomposition. The weathered and decomposed zones are sufficiently permeable to transmit small quantities of water and are tapped by many domestic and stock wells and also yield water to numerous small springs located along the base of the Diamond Mountains.

c. Recharge and Movement of Ground Water

The upland recharge areas, shown on MAP 12, consist of Plio-Pleistocene and Pleistocene basalt flows. Most of the recharge originates as precipitation which infiltrates the basalt and then percolates laterally to and beneath the valley floor area. (See Climate section for more information on precipitation.) An unknown amount of subsurface inflow may enter Honey Lake Valley from Secret Valley through Pliocene lake sediments which appear to be continuous beneath the lava field separating the two valleys.

Honey Lake Valley ground water basin contains both unconfined and confined ground water bodies, but data to define the separate bodies are lacking.

Because Honey Lake Valley is a closed basin with no surface outlet, ground water movement is largely controlled by topography, and the general direction of ground water movement is toward Honey Lake. Susan River and Baxter Creek appear to be effluent streams, i.e., are fed by ground water throughout a portion of their courses. Conversely, Long Valley Creek is an apparently influent stream along a portion of its course and contributes water to underlying aquifers during periods of intermittent flow. Both the effluent and influent streams affect the elevations of ground water and the movement of ground water in the areas adjoining their channels.

Flowing wells located along the northern edge of the valley floor south of the Amedee Mountains are probably supplied by ground water confined in buried lava aquifers which are extensions of the lavas comprising the

adjacent mountains. Flowing wells located along the southwestern edge of the valley floor tap confined aquifers in the lower portions of alluvial fans and adjoining near-shore deposits.

The essentially unconfined ground water in the vicinity of Herlong appears to be recharged by Long Valley Creek. Wells of the Sierra Ordnance Depot penetrate deep aquifers of confined ground water. The Island is apparently underlain by a shallow perched ground water body on top of the pre-Lahontan lake deposits.

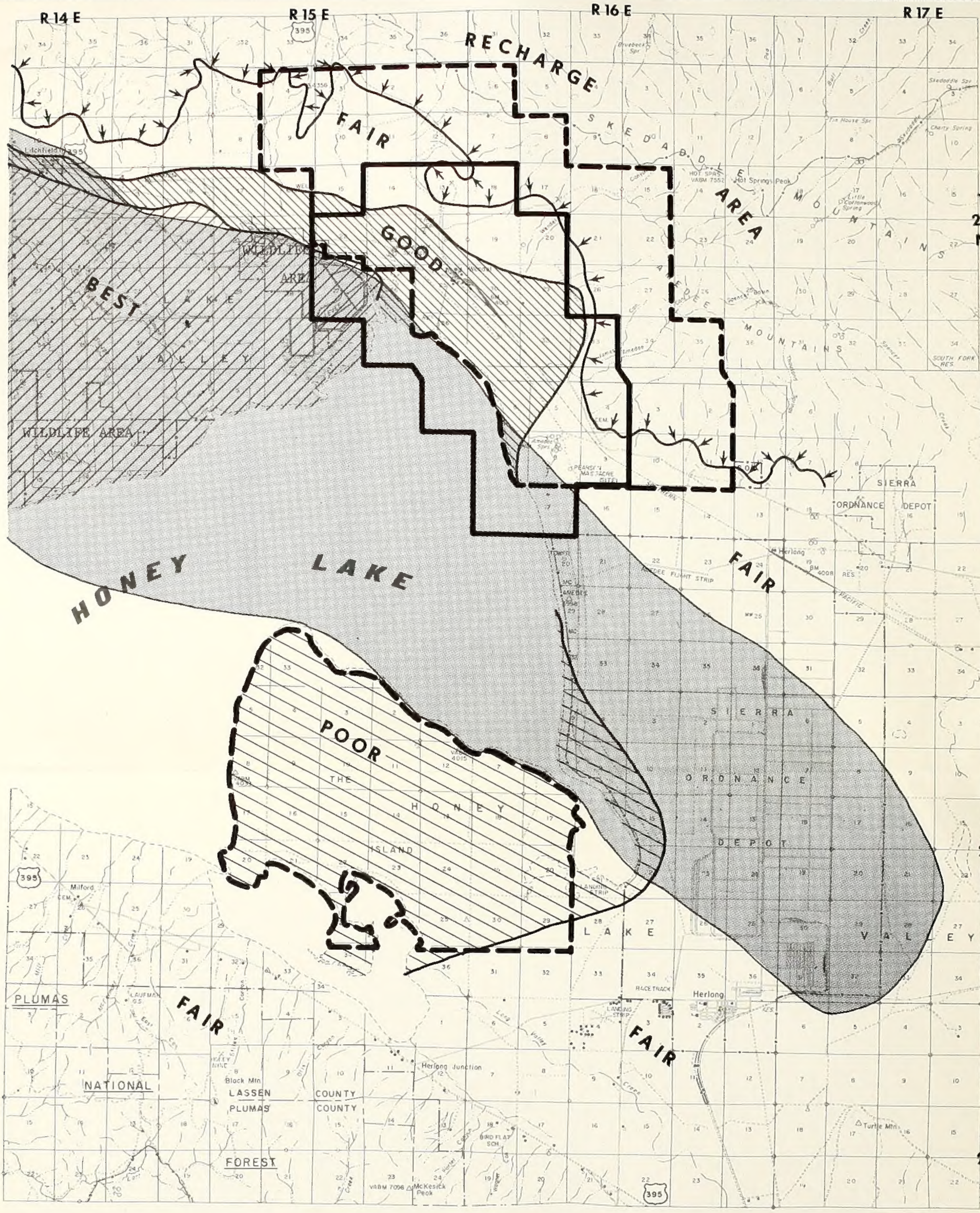
Springs in Honey Lake Valley fall into three groups: springs which flow from joints and fissures in lavas in the northern and eastern parts of the valley; thermal springs which emerge along faults; and springs which result from the interception of the ground surface and the water table. Wendel and Amedee Hot Springs are prominent examples of the second type. The many small springs and seeps along the southwestern edge of the valley are of the third group.

d. Ground Water Storage Capacity

Ground water storage capacity to a depth of 750 feet has been estimated to be about 16,000,000 acre-feet. How much of this quantity is usable, or how much usable storage exists below 750 feet is not presently known. It is reasonable to assume that a significant amount of ground water could be developed. The safe yield of the Honey Lake ground water basin is estimated to be 38,000 acre-feet per year (State Water Control Board, 1973).

e. Quality of Ground Water

Ground waters in Honey Lake Valley vary greatly in mineral quality. South of Herlong and along the southwestern side of Honey Lake they are usually excellent in quality and generally range from calcium to sodium bicarbonate in character. Similar waters are found south and east of Bald Mountain, near Buntingville and Janesville. These waters are suitable for most beneficial uses. Good quality ground waters are generally found in that portion of the Susan River drainage area northwest of Bald Mountain, but about 60 percent of the wells in the portion east of Bald Mountain yield poor quality waters. Some of these waters are not recommended for domestic use, while others are considered hazardous for irrigation use. A few are considered hazardous for either use. The ground waters found in the valley east of Honey Lake and north of the Southern Pacific Railroad are generally of good quality and are usually sodium bicarbonate in character. The few wells in the area east of Honey Lake between the Southern Pacific Railroad and Herlong yield poor quality waters of variable character. TABLE 27 gives a summary of ground water quality from selected wells in the valley. TABLE 28 shows analysis of waters from Amedee Hot Springs.



LEGEND

- Study Area Boundary
- Recharge Area
- Poor
- Fair
- Good
- Best
- Arsenic

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

GROUND WATER AVAILABILITY

MAP-12

SCALE: ½" = 1 MILE   MT. DIABLO MERIDIAN

TABLE 27

QUALITY OF WATER FROM SELECTED WELLS AND SPRINGS IN SUSANVILLE-HONEY LAKE AREA

(Data from files of California Department of Water Resources)

Location	Name	Date Sampled (mo/dy/yr)	Producing Depth (m)	Altitude (m)	Water Temperature (°C)	pH	Conductivity (umhos/cm)
SW/SE Sec. 23 T. 29N., R. 15E., M.D.	Wendel Hot Springs	7/17/73	spring	1231	95.6	8.38	3.34
NE/SW Sec. 30 T. 29N., R. 16E., M.D.	Southern Pacific Railroad	7/17/73	93	1223	28.2	8.33	0.332
NW/NE Sec. 8 T. 28N., R. 16E., M.D.	Amedee Hot Springs	7/17/73	spring	1219	95.1	8.43	2.86

CHEMICAL CONSTITUENTS (in mg/1)

Sample Number	Li	Na	K	Cations Rb	Mg	Ca	Zn	F	Cl	Anions HCO_3	CO_3	SO_4	Others SiO_2	B	Calculated Dissolved Solids
1	0.12	280	7.5	0.04	0.1	18	0.015	4.1	190	50	1	360	120	5.5	1040
2	0.01	58	8.0	0.01	2.2	6.0	0.005	0.2	17	112	1	32	42	0.22	279
3	0.08	250	5.5	0.02	0.1	14	0.005	4.4	160	44	2	300	95	4.0	879

Trace Constituents Below Detection:

Ca 0.1, Kn 0.01, Fe 0.06, Cd 0.01, Co 0.05 Cu 0.02, Ni 0.04, Pb 0.1

(After Hardt, et al., 1975)

TABLE 28

ANALYSIS OF WATERS FROM AMEDEE SPRING

(from Tunell, 1970)

Dissolved substance in ppm	
SiO_2	96.0
Al_2+	0.23
Fe_{3+}	
Fe	0.01
Mn	0.00
Ti	0.16
As	0.02
Ca	16.0
Mg	0.0
Sr	0.0
Ba	0.05
Na	227.0
K	6.8
Li	0.0
NH_4	0.5
HCO_3	27.0
CO_3	10.0
SO_4	288.0
Cl	160.0
F	4.5
Br	0.2
I	0.1
NO_2	0.00
NO_3	0.0
PO_4	0.40
B	4.1
H_2S	0.2
Sb	n.d.
Hg	n.d.

f. Water Quality Problems

Ground waters in a closed basin such as Honey Lake Valley are continually subject to water quality impairment resulting from use and reuse. With each use some water is lost from the basin but most of the soluble salts remain, and with some uses additional salts are added. As a result, in the lower portions of a closed basin, poorer quality waters are usually found (MAP 12). Two such areas within this basin contain ground waters of hazardous quality. The poor quality waters found in these areas show great variation in both character and quality. Available water quality data indicate that although reuse is probably responsible for much of the impairment, some of it is the result of mineralized water rising along fault zones. Although waters of usable quality can be found within the hazardous areas, more often waters containing excessive concentrations of arsenic, boron, fluoride, nitrate, or an excessive amount of total dissolved solids will be encountered. Continuing reuse of ground waters may in the future cause increased impairment with the result that these waters may be rendered unusable.

Scattered throughout Honey Lake Valley are other wells yielding ground waters which contain excessive concentrations of one or more of the following constituents: boron, iron, fluoride, arsenic and nitrate. However, these appear to be only localized conditions of impairment.

Ground water has been promising and as a result many new irrigation wells have been developed in the past five years. Judging from the location and discharge of thermal springs and ground water movement in the area, however, the possibility of surface water contamination by thermal fluids does exist. Preliminary investigations in the area show higher than expected concentration of As and F in the Susan River at Litchfield, suggesting such contamination (Lawson, Personal Communication, 1976).

Anticipated future development in Honey Lake Valley will be accompanied by population growth and expansion of urban, recreational and irrigation areas. This growth and expansion will increase the demand for available water resources and will further aggravate the adverse salt balance in the basin.

g. Present Use of Ground Water

The major portion of the 21,000 acres of irrigated lands within the valley floor of Honey Lake Valley ground water basin receive irrigation water from the Susan River. Irrigation water is obtained from both storage developments and direct diversion. The present supply of water from the Susan River and other streams is insufficient to irrigate the 185,000 acres of valley floor lands classified as irrigable. During recent years, ground water has been developed to supplement surface water irrigation supplies. More than 2.600 acres are presently irrigated entirely from ground water. There are presently about 125 irrigation wells and about 500 domestic and stock wells in Honey Lake Valley.

The yields from some of these wells are insufficient for their intended use, while the yield from others exceeds 2,000 gallons per minute.

h. Ground Water Development Potential

The greatest potential for ground water development in the Honey Lake Valley exists in several areas: (1) between Susanville and Johnstonville, an area underlain by permeable lake deposits and buried lava aquifers which have an excellent opportunity for recharge; (2) in the vicinity of Standish and Herlong, an area believed to be composed of coarse sands deposited by ancestral streams along the courses of the Susan River and Long Valley Creek; and (3) south of Doyle, where coarse alluvial fan deposits occur adjacent to Long Valley Creek.

Other areas of good potential for ground water development are fairly well distributed throughout Honey Lake Valley and most irrigation requirements can be supplied from the underlying permeable lake and near-shore deposits. If lava aquifers are found interbedded within the lake deposits, the ground water potential of these areas would approach that of the areas discussed above.

4. Climate, Air, Noise

Climate

The climate of the Honey Lake Basin within which both geothermal areas lie is transitional between the mountainous areas with summer drought, winter moisture, warm summers, and cold winters at Susanville, and the level lowlands with summer drought, warm summers and cold winters at Doyle.

Moving eastward across the basin the climate becomes drier and the seasonal temperature ranges larger. The climate in the general location of the two geothermal areas could be classified as a desert climate which is characterized by great diurnal and annual ranges in temperature and extremely light precipitation.

a. Precipitation

The major source of precipitation is moisture-laden air masses moving eastward across the State from the Pacific Ocean. Much of the moisture in these air masses is lost as they are lifted moving across the Coast Range and the Sierras. Precipitation decreases rapidly with decrease in elevation down the eastern slope and is generally less than half of that of a comparable elevation on the western slope.

The Diamond Mountain Range to the southwest is the major control factor of the micro-climate within the basin. The range rises 3,000 feet above the basin and is an effective barrier and extracts much precipitation from eastern-moving storms.

There are three stations within the basin at which consistent weather data are collected; Susanville Airport, Doyle and the Fleming Fish and Game Unit. Two other stations, Standish and Wendel, are located within the basin, but data here are not collected regularly.

The Fleming Fish and Game weather station is located about one mile west of the Wendel-Amedee area and about seven miles north of the Island area and therefore should be most representative of the weather in these two areas.

Fleming has an annual mean temperature of 49.1^{o}F with January being the coldest month with a monthly mean of 30.1^{o}F and July being the warmest with a monthly mean of 69.2^{o}F.

The frost-free season at Fleming is shorter than both Susanville and Doyle. The average is 139 days, the longest season being 183 days in 1963 and the shortest 117 days in 1964. Data have been collected at this station for the past 15 years only.

Figure 8 shows the total annual precipitation for the past 20 years or for those years for which data are available and the mean annual precipitation for these five stations. As the distance east from the Diamond Range increases, the precipitation decreases, from 14.48 inches annually in Susanville to an annual average of 7.22 in Wendel.

Figures 9, 10 and 11 show the mean monthly precipitation for Susanville, Doyle and Fleming Fish and Game respectively, along with their mean temperature curves. All three stations receive their maximum precipitation in January and from 70-80 percent of their annual precipitation during the winter months, October through March, most of which is in the form of snow. Susanville has an average yearly snowfall of 57.6 inches and Doyle has a 21.7 inch average. There can be considerable variation in annual precipitation from year to year as can be seen in Figure 11 which shows an annual precipitation of about 7.1 inches in Susanville in 1961 as compared with almost 25 inches in 1962.

The precipitation in the Wendel-Amedee area varies from about six inches annually on the southwest to almost ten inches annually on the northeast. The major reason for the greater precipitation to the northeast is the increase in elevation.

The Island area is slightly drier with an annual precipitation range of about four inches on the northeast to approximately nine inches on the southwest. There is an area about eight miles in diameter over the Sierra Army Depot where the precipitation is four inches annually or less with precipitation increasing with distance from this center. The shadow effect of the surrounding mountains and the Honey Lake basin are probably the major factors contributing to this very dry climate.

Figure 8

Annual Precipitation in Inches

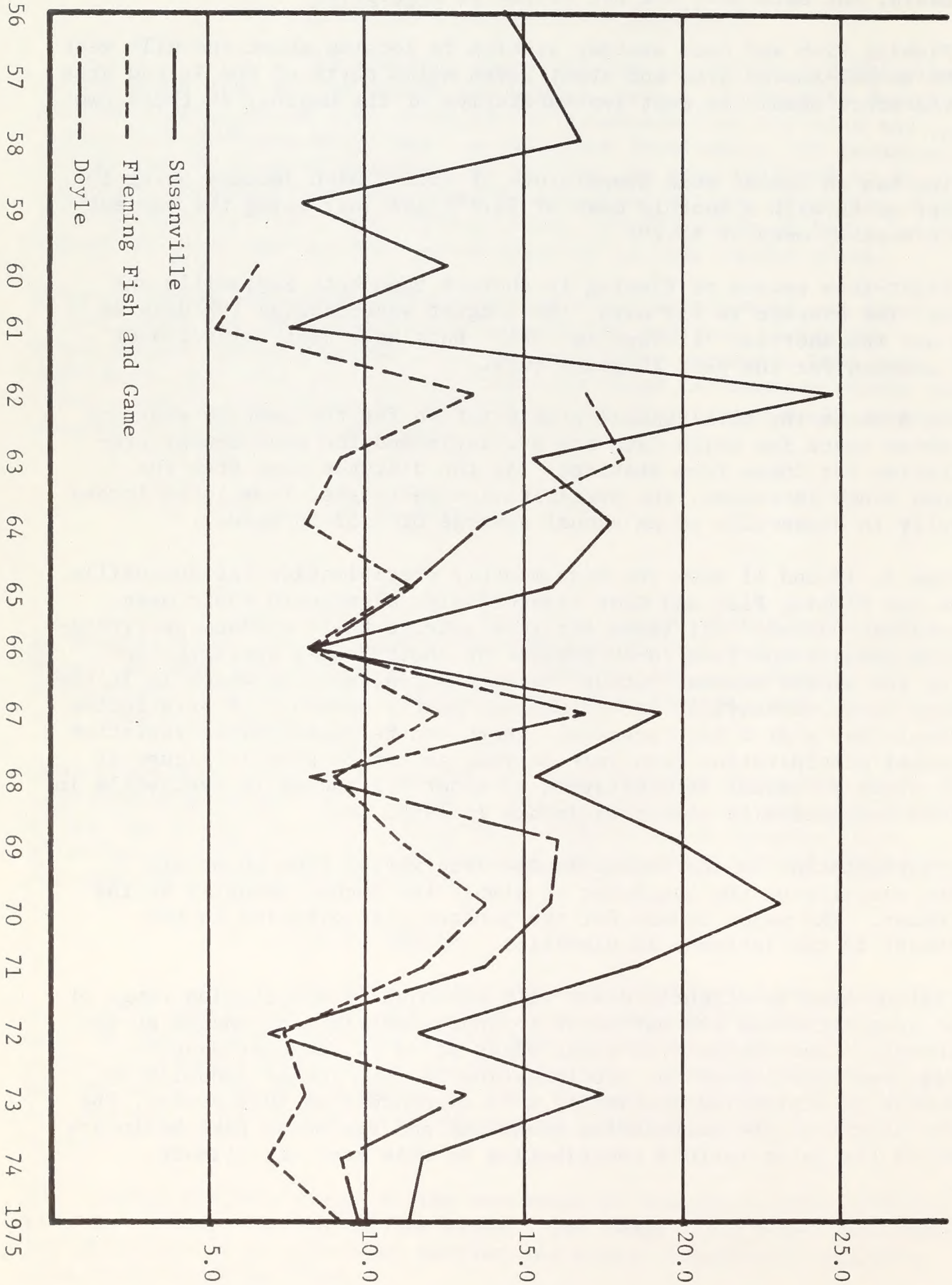
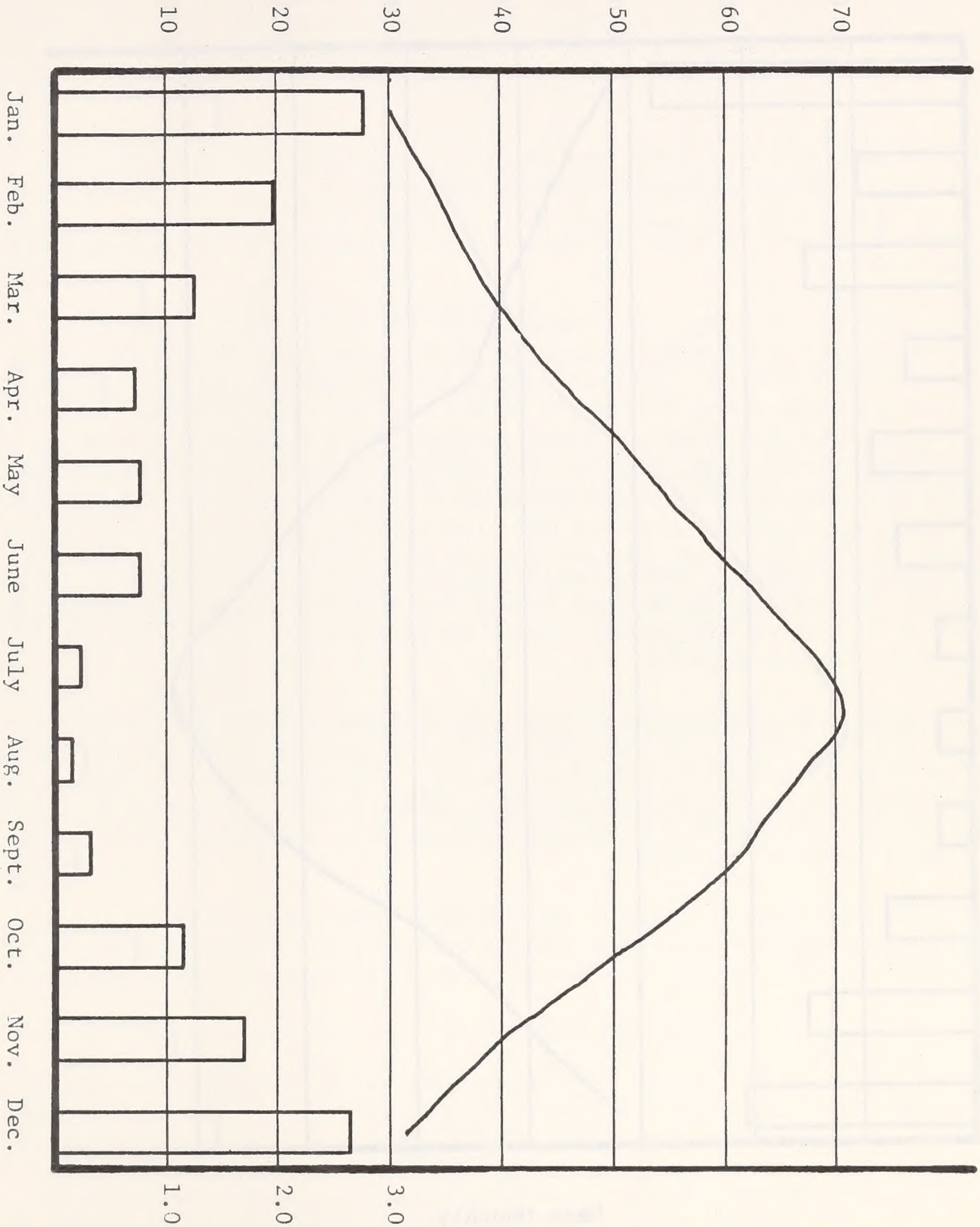


Figure 9

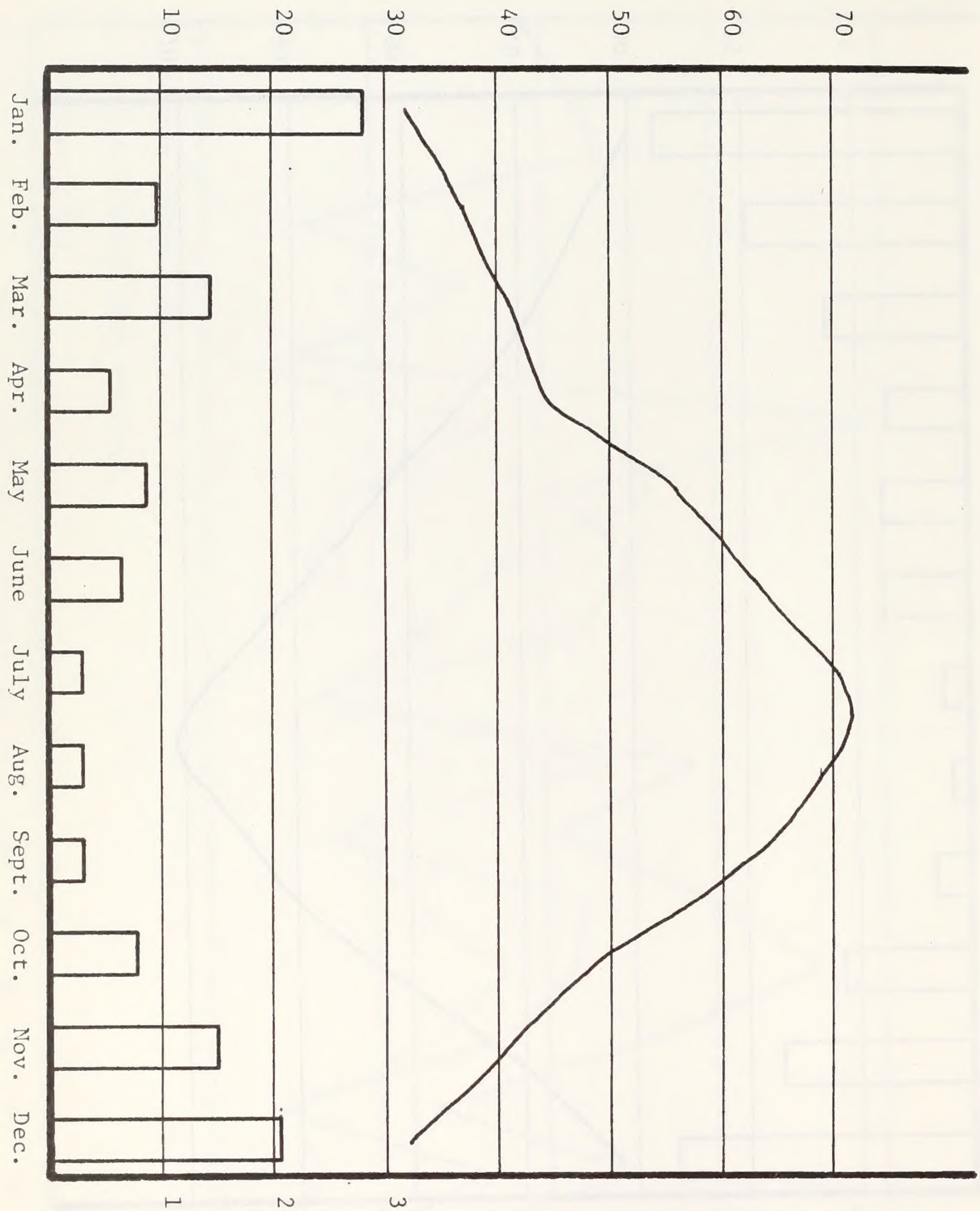
Mean Temperature Curve in °F
Susanville, California



Mean Monthly
Precipitation Bars in Inches

Figure 10

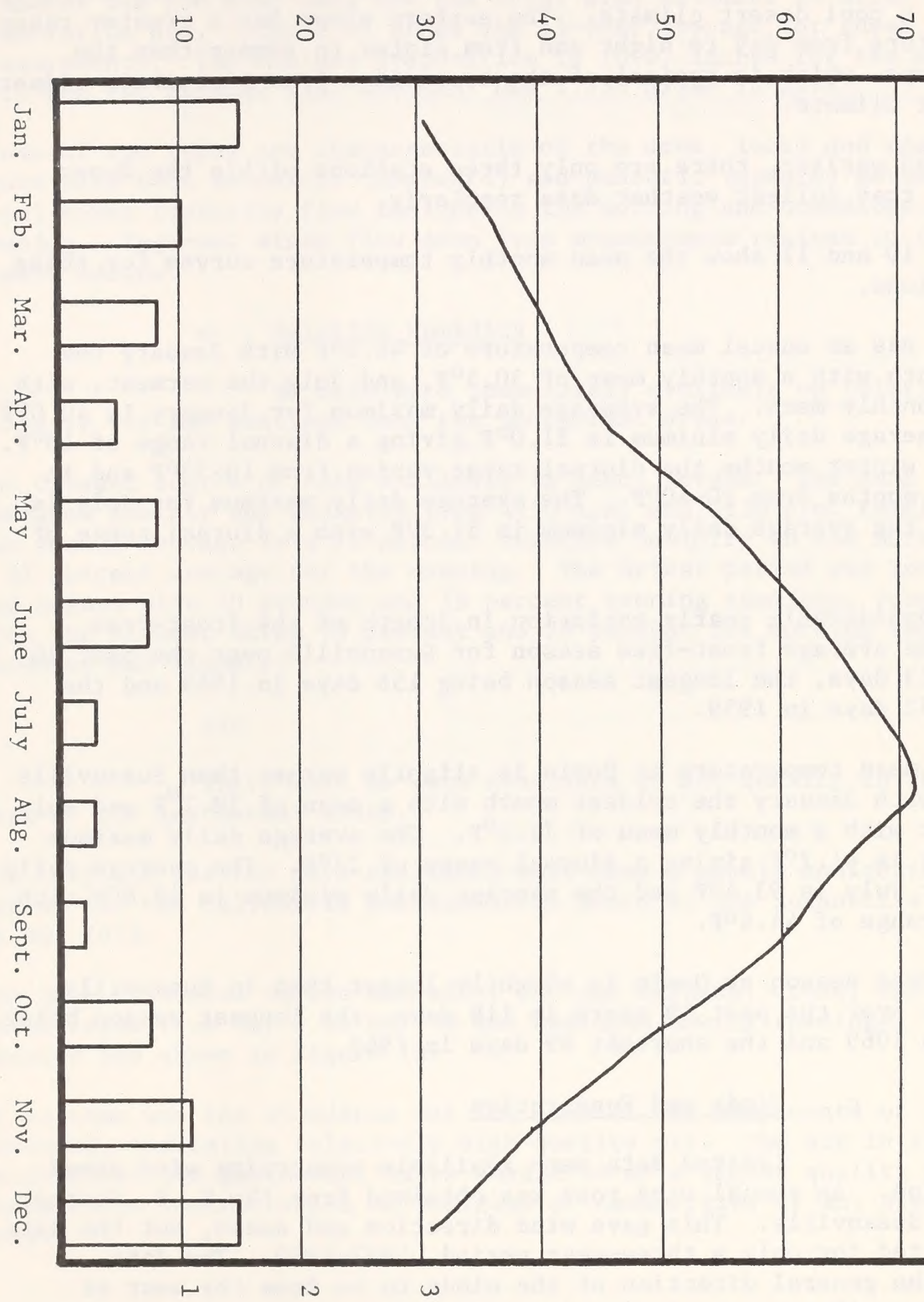
Mean Temperature Curve in ^{o}F
Doyle, California



Mean Monthly
Precipitation Bars in Inches

Figure 11

Mean Temperature Curve °F
Fleming Fish and Game



Mean Monthly
Precipitation Bars in Inches

b. Temperature

The climate in the Wendel-Amedee and Island areas is characterized by great diurnal and annual ranges in temperature which is typical of a cool desert climate. The eastern slope has a greater range in temperature from day to night and from winter to summer than the western slope, which is typical of the transition from a mountain climate to a desert climate.

As mentioned earlier, there are only three stations within the Honey Lake basin that collect weather data regularly.

Figures 9, 10 and 11 show the mean monthly temperature curves for these three stations.

Susanville has an annual mean temperature of 48.8°F with January the coldest month with a monthly mean of 30.5°F, and July the warmest, with a 70.3°F monthly mean. The avaerage daily maximum for January is 40.0°F and the avaerage daily minimum is 21.0°F giving a diurnal range of 19°F. During the winter months the diurnal range varies from 10-25°F and in the summer months from 20-40°F. The average daily maximum for July is 88.1°F and the average daily minimum is 51.3°F with a diurnal range of 36.8°F.

There is considerable yearly variation in length of the frost-free season. The average frost-free season for Susanville over the past 20 years is 113 days, the longest season being 156 days in 1969 and the shortest, 72 days in 1959.

The annual mean temperature at Doyle is slightly warmer than Susanville at 49.8°F with January the coldest month with a mean of 30.7°F and July the warmest with a monthly mean of 71.3°F. The average daily maximum for January is 41.7°F giving a diurnal range of 22°F. The average daily maximum for July is 93.4°F and the average daily minimum is 48.8°F with a diuranl range of 44.6°F.

The frost-free season at Doyle is slightly longer than in Susanville. The average over the past 19 years is 118 days, the longest season being 154 days in 1969 and the shortest 89 days in 1968.

c. Winds and Evaporation

Limited data were available concerning wind speed and direction. An annual wind rose was obtained from the U. S. Weather Bureau for Susanville. This gave wind direction and speed, but the data were collected for only a three-year period, 1937-1940. The data indicated the general direction of the winds to be from the west or southwest over 45 percent of the time. The wind speed, indicated by directions, varied with a maximum of slightly over nine miles per hour for the west wind, eight miles per hour for a southwest wind, down to a calm 3.1 percent of the time.

Wind and evaporation data were collected at only the Fleming Unit, and only during the months of April through October. Evaporation data are measured in inches from a standard weather service-type pan of four foot diameter and the wind data are the total wind movement in miles over the evaporation pan. Figure 12 shows the 15-year average for these two measurements. The maximum evaporation is 10.07 inches for the month of July and the maximum wind movement was 1,735 miles in April.

Winds of two types are characteristic of the area, local and regional winds with both katabatic (downward) and anabatic (upward) movement. Local winds typically flow upslope in the morning and downslope in the evening. Regional winds flow down from mountainous regions to the desert basins.

d. Relative Humidity

No data were immediately available on relative humidity for any stations near the geothermal areas.

The closest source of data available is Reno, Nevada. The data are averaged monthly and annually from 4:30 a.m. and 4:30 p.m. readings. The annual average is a 71 percent relative humidity in the morning and a 35 percent average for the evening. The driest period was for July and August with 20 percent and 19 percent evening readings, respectively, with the highest being 79 percent and 78 percent for morning readings in December and January.

Air

There were no data available on air quality in the immediate area of the geothermal areas.

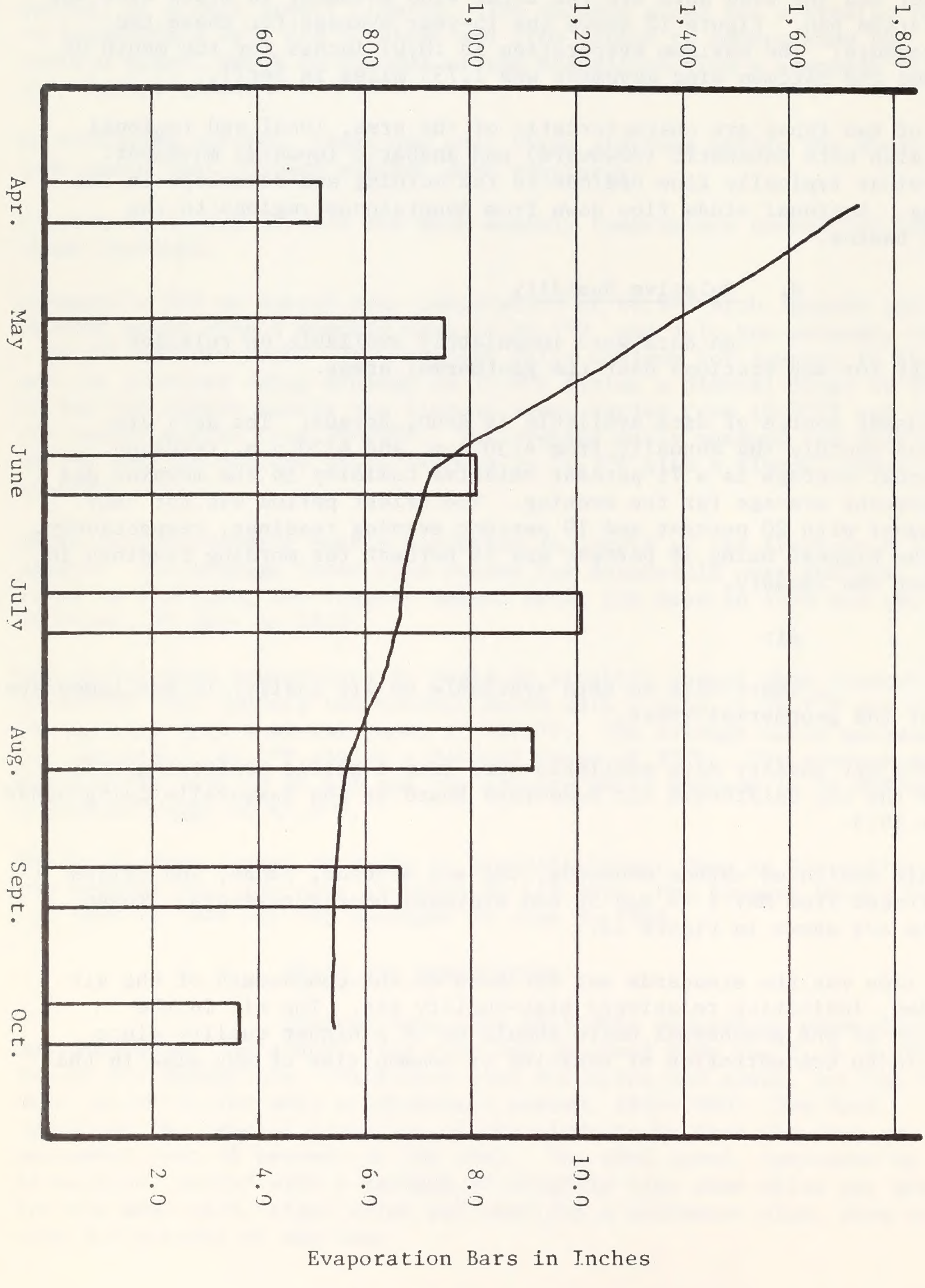
The only air quality data available were from a mobile monitoring unit set up the the California Air Resources Board at the Susanville fairgrounds in May 1973.

The unit monitored carbon monoxide, THC and methane, ozone, and oxides of nitrogen from May 2 to May 30 and averaged hourly readings. These results are shown in Figure 13.

At no time was the standards set for each of the components of the air exceeded, indicating relatively high-quality air. The air in the vicinity of the geothermal units should be of a higher quality since there is no concentration of vehicles or communities of any size in the area.

Figure 12

Wind Movement in Miles
Susanville, California



Evaporation Bars in Inches

FIGURE 13

AIR QUALITY

SUSANVILLE FAIRGROUNDS, MAY 1973

	Maximum Hourly Average (ppm)	Average of Maximum Hourly Average (ppm)	No. of Times Standard Exceeded
Carbon monoxide	1	1	0
Ozone	.05	.036	0
Total hydrocarbons	2.0	1.58	0
Methane*	2.0	1.56	0
NO_x	.05	.021	0
NO	.04	.01	0
NO_2	.03	Unknown	Unknown

* Methane = 99 percent of total hydrocarbons.

Source: California Air Resources Board, Susanville Fairgrounds, May 1973.

There are periods when inversion layers develop over the Honey Lake basin trapping warm air below a cold air layer. During these periods, the air quality may deteriorate considerably. Emissions from vehicles, chimneys and industrial smokestacks are trapped below this layer increasing the pollutants in the air greatly. These inversions last for only a couple of days at the most, and the air quality is back to normal shortly after the inversion layers dissipate.

During dry years, high winds can increase the amount of particulate matter in the air considerably. Many areas of sparse vegetation and dry portions of Honey Lake are the main sources of this particulate matter. The particulate matter increases towards the east or northeast from Susanville with this being the prevailing direction of the wind.

Particulate matter and other air pollutants are also emitted into the air during demolition of munitions by the Sierra Army Depot, directly to the east of the Wendel-Amedee area. This occurs a few days per month with most pollutants dissipating within a few hours.

Although the air quality of the Honey Lake basin is very good, it can be anticipated that since it is a basin, increased industry and population could have a detrimental effect on the overall air quality.

Noise

Noise may arise from either natural or man-made causes. Natural noises are those sounds caused by animal cries and calls, geologic activity, or weather activity. Except for periods of severe geologic or weather phenomenon such as earthquakes, volcanic eruptions and severe electrical storms or thunderstorms, most of the natural noises would be of a low to moderate level.

Sound results when a source sets a medium, air in most instances, into vibrations. Noise is identified as an unpleasant or painful sound and is subjective depending on an individual's preference. Sound is most commonly measured on the decibel scale which indicates the level or intensity. One decibel is the lowest level audible to the human ear and 120 dB is the threshold of pain.

In an open environment free from obstruction, sound decreases by 6 dB for every doubling of distance from the source.

Man-made noises audible in the two geothermal areas can be attributed to vehicular traffic and man's movement across the land. The Wendel-Amedee area is bisected by both a county highway and a railroad which are probably accountable for the majority of the noise in this area. The Sierra Army Depot has a large airstrip about two miles south of the Wendel-Amedee area which is used by planes up to large cargo jet size. The frequency of these flights is not known but appears to be only occasional. The sound level produced by jet aircraft is about 125 db(A) at 300 feet and a freight train produces about 70 dB(A) at 100 feet.

Probably the loudest man-made noise in the area is from the Sierra Army Depot demolition area located three and one-half miles to the east. The site is used to explode out-dated and obsolete munitions that are stored in the area. Considering a maximum blast of 10,000 pounds of explosives, the noise level would vary from about 160 decibles within one-half mile of the blast to 130 decibels 20 miles away. This is considered to be the maximum level to be expected under any conditions. Most blasts are in the range of 3-4 thousand pounds averaging about 50 in number per year. The noise level in various areas will depend on air density and temperature and local topography.

Noises around the Island area are of a similar nature to those of the Wendel-Amedee area. Traffic noises may be audible in certain areas from U.S. Route 395 one mile to the southwest. The Sierra Army Depot airstrip is about four miles to the northeast and the demolition area is about nine miles to the northeast and would contribute to noise audible on the Island.

No known measurement of noise levels, other than those of the demolition site, have been taken at either area but most noises can be attributed to man, especially those in the higher decibel ranges.

B. Living Components

1. Vegetation and Livestock

The plant communities within the study area are of the type found in the cold desert biome and typical of the northeastern Great Basin.

Vegetative types and associations of types included within the project area are: (1) annual grass type (2) sagebrush-bitterbrush-bluebunch wheatgrass association (3) greasewood association (4) saltgrass association (5) salt desert shrub type and (6) cropland. (MAP 13)

Vegetation Types and Associations

a. Grass (Burned-Over Area) (TABLE 29-32)

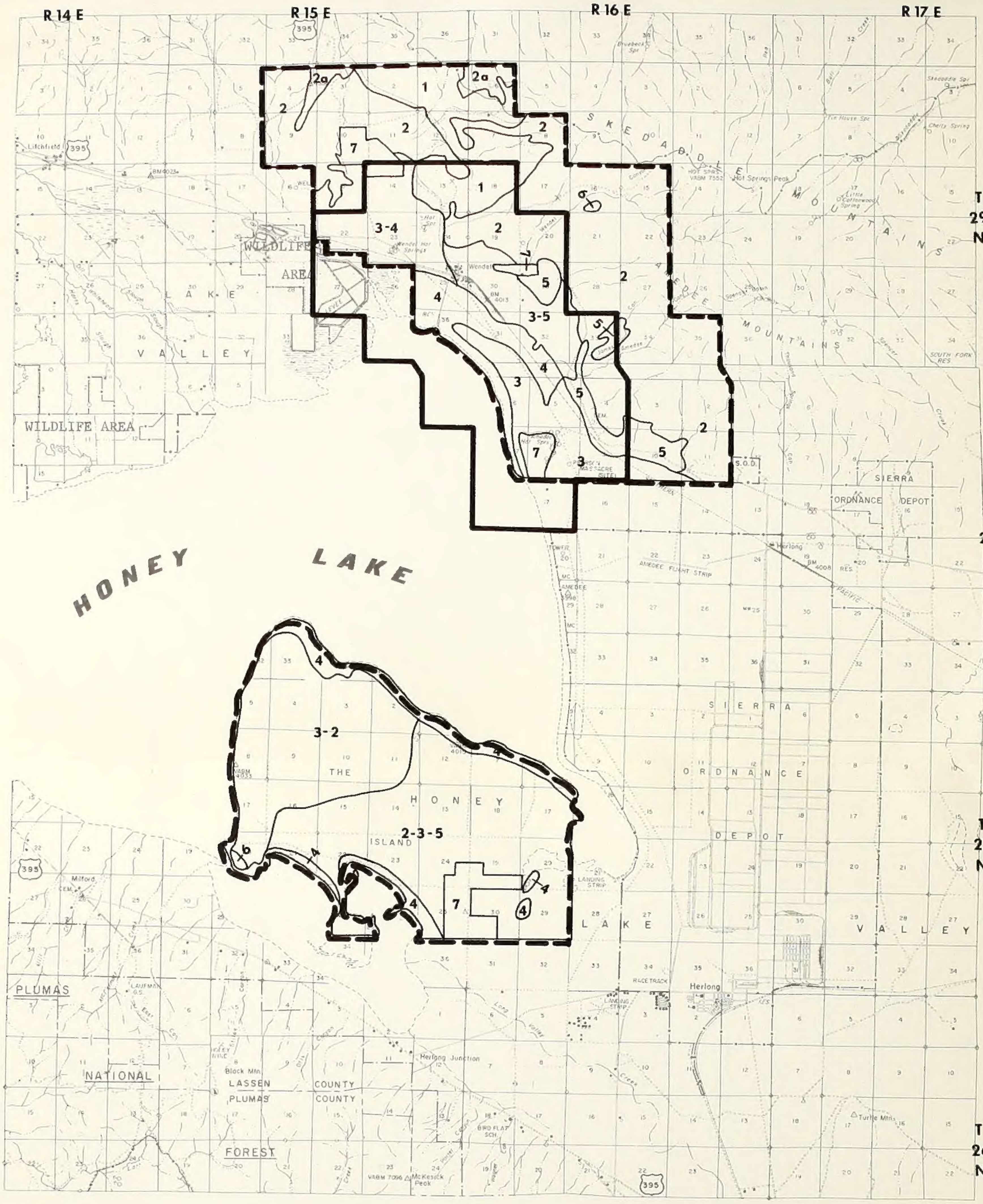
The grass type that occurs within the study area and generally north of the Southern Pacific Railroad tracks is primarily an annual brome grass (Bromus tectorum) with occasional native perennial grass plants of squirreltail (Sitanion hystrix) and needlegrass (Stipa thurberiana). The principal forbs in this type are tumble mustard (Sisymbrium altissimum), Gayophytum ramosissimum, Russian thistle (Salsola kali), skeleton weed (Lygodesmia spinosa), tansy mustard (Descurania pinnata), and popcorn flower (Plagiobothrys spp.). This area has been subject to repeated burning and there is very little brush within this type. It was originally a big sagebrush type with a predominantly perennial grass understory.

b. Sagebrush - Grass Association (TABLE 29-32)

This association comprises approximately 44 percent of the vegetation on national resource lands within the study area. The vegetative composition varies considerably depending upon (1) the site (2) past grazing practices (3) fires and (4) other activities of man. Big sagebrush (Artemisia tridentata), the dominant plant in this association, occupies flatlands, slopes and the mountains where the soil is relatively porous and drainage is good. The over-wintering leaves of sagebrush are lost when growth begins in the spring and leaf fall is most rapid during periods of hot weather. Small native annuals may be present for a few weeks during a moist spring. Other typical shrubs of the well-drained upland sites are rabbitbrush Chrysothamnus nauseasus and C. viscidiflorus), Mormon tea (Ephedra viridis), horsebrush (Tetradymia glabrata and T. canescens), and squaw currant (Ribes cereum). Typical forbs of the upland sites are lupine (Lupinus spp.), mules ear (Wyethis mollis), arrowleaf balsamroot (Balsamorhiza sagitata), tumble mustard (Sisymbrium altissimum), Gayophytum ramosissimum, skeleton weed (Lygodesmis spinosa), and popcorn flower (Plagiobothrys spp.). Bluebunch wheatgrass (Agropyron spicatum), Thurber needlegrass (Stipa thurberiana), squirreltail (Sitanion hystrix), Great Basin wildrye (Elymus cinerius) and cheatgrass (Bromus tectorum) are the most common grasses of the upland sites of the big sagebrush type. There are some steep, rocky north-facing slopes in Wendel-Amedee area on which bluebunch wheatgrass dominates the aspect and big sagebrush is a secondary component. There is also a small area (60 acres ±) in the Wendel Canyon where antelope bitterbrush (Purshia tridentata) is the dominant shrub.

On the lower slopes of the Wendel-Amedee area and on the Island area to the south side of Honey Lake the soils tend to be somewhat saline and alkaline in nature. Within the big sagebrush type on these sites rubber rabbitbrush (Chrysothamnua nauseosus), horsebrush (Tetradymia canescens), greasewood (Sarcobatus vermiculatus), shadscale (Atriplex confortifolia), and spiny hopsage (Grayia spinosa) are common shrubs. Lupine and buckwheat (Eriogonum spp.) are common forbs at the lower elevations and on the Island area. Cheatgrass, squirreltail, sandberg bluegrass (Poa secunda), Great Basin wildrye, and western wheatgrass (Apropyron smithii) are the principal grasses on the lower slopes of Wendel-Amedee area. Creeping wildrye (Elymus triticoides) and Great Basin wildrye are the principal grasses in the sagebrush type on the Island area.

There are small areas of low sagebrush (Artemisia arbuscula) on shallow sites, and generally at the high elevations of the Wendel-Amedee area. The principal shrubs associated with the low sagebrush type are rabbitbrush, horsebrush, and Mormon tea. The most abundant grasses are Cheatgrass, Sandberg bluegrass, squirreltail, bluebunch wheatgrass, Thurber needlegrass, Idaho fescue, one-spike oatgrass (Danthonia unispicata), Japanese brome (Bromus japonicus), and rattlesnake brome (Bromus brizaeformis). The low sagebrush type is characterized by a great diversity of broadleaved herbs. The more common forbs in the type are cutleaf balsamroot (Balsamorhiza hookerii), beard-tongue (Penstemon spp.),



LEGEND

Study Area Boundary

1 — Grass-Burned over area

2 — Sagebrush-Grass Association

2a — Low Sagebrush

3 — Greasewood

4 — Saltgrass

5 — Salt Desert Shurbs

6 — Bitterbrush

7 — Cropland

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

VEGETATION

MAP-13

SCALE: ½" = 1 MILE MT. DIABLO MERIDIAN

TABLE 29

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Vegetative Types and Associations of Types

Types and Associations	Subtypes	Potential Lease Units	Acres	Density	Major Species	Percent Comp.	Livestock Carrying Capacity Approximate (1) Acres/AUM	Noxious Weed Species
Grass (Burned Over Area)		No. 1	200	37%	Brte	60	9	
		No. 5	780		Sihy	1		
					Posc	1		
					Erci	1		
					ANN (See Narrative)	12		
					Artr	12		
					Putr	1		
					Chna	12		
Sagebrush-Grass Association	Big Sagebrush	No. 1	540	27%	Brte	16	15	
		No. 2	1,080		Agsm	T		
		No. 3	531		Feid	T		
		No. 5	420		Pose	2		
		No. 6	410		Stth	1		
		No. 7	620		Sihy	4		
		No. 8	150		Pone	1		
		No. 9	960		Agsp	1		
		No. 10	499*		Posc	1		
		No. 11	783		Elci	1		
					Orhy	1		
					ANN	2		
					ERIO	1		
					LUPI-S	1		
					Basa	1		

(1) Deductions for slope, distance from water, rocky taluses and other factors for livestock not shown.

* Private land with minerals reserved to the U. S.

TABLE 29 (Continued)

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Vegetative Types and Associations of Types

Types and Associations	Subtypes	Potential Lease Units	Acres	Density	Major Species	Percent Comp.	Livestock Carrying Capacity Approximate (1) Acres/AUM	Noxious Weed Species
Grass Asociation (con't.)					Artr	40		
					Putr	1		
					Epne	1		
					Arar	2		
					RIBS	2		
					Chna	6		
					Chla	3		
					Grsp	3		
					Teca	2		
					Pran	2		
					Atco	2		
					Save	4		
	Low Sagebrush			20%	Brte	6	22	
					Sihy	6		
					Fere	1		
					Pose	4		
					Agsp	3		
					Stip	2		
					ANN	3		
					BRAS	1		
					Loam	1		
					ERIO	1		
					Arar	65		
					Artr	6		
					Putr	1		

TABLE 29 (Continued)

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Vegetative Types and Associations of Types

Types and Associations	Subtypes	Potential Lease Units	Acres	Density	Major Species	Percent Comp.	Livestock Carrying Capacity Approximate (1) Acres/AUM	Noxious Weed Species
Greasewood		No. 2	40	29%	Elci	2		
		No. 4	320*		Dist	8		
		No. 6	265		Brte	1	17	
		No. 7	430		Sihy	1		
		No. 8	1,084					
		No. 9	96		Ivax	3		
					ANN	3		
					Chna	9		
					Save	42		
					Artr	23		
					Arsp	1		
					Atco	1		
					Tegl	1		
					Chla	1		
					Grsp	4		
Saltgrass		No. 5	5	40%	Dist	50	5.4	
		No. 6	195		Carex spp.	1		
		No. 7	120		Scne	4		
		No. 8	20		Pule	T		
		No. 10	120 (Brush Control) 57 N.R.L.		Trma	1		
					Nioc	42		
					Save	2		
		No. 11	20					

* Private land with minerals reserved to U.S.

TABLE 29 (Continued)

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Vegetative Types and Associations of Types

Types and Associations	Subtypes	Potential Lease Units	Acres	Density	Major Species	Percent Comp.	Livestock Carrying Capacity Approximate (1) Acres/AUM	Noxious Weed Species
Desert Shrub		No. 3	110	30%	Elci	1		Halogeton glameratus small patches along roadside and on small tracts east of Wendel to Nevada line.
		No. 6	250		Sihy	2		
		No. 7	190		Dist	14		
					Pose	1		
					Brte	2		
					ANN	3		
					Ivax	5		
					LEPI	1		
					Arsp	1		
					Atco	5		
					Chna	16		
					Artr	32		
					Save	14		
					Grsp	1		
					Chvi	1		
					Teca	1		
Mt. Shrub (Bitterbrush)					See Living Components - Vegetation - Narrative Sagebrush-Grass Association			
Irrigated Cropland		No. 10	120		Medicago Sative - Seed production			
			135		Barley			

TABLE 30

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Buffer Zone - Mountain Type - Wendel Amedee Area

Vegetation Types by Acres by Ownership Status

Location	Grass (Acres)		Sagebrush-Grass (Acres)		Low Sage-brush (Acres)		Greasewood (Acres)		Saltgrass (Acres)		Salt Desert Shrub (Acres)		Bitter-brush (Acres)		Cropland (Acres)	Other
T 29 R 15	P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	
Sec. 1		600		20		20										
2		440				200										
3		30		440		170										
4				430	160	50										
9			130	450		30										
12	20															
13	260															
Sub Totals	280	1070	130	1340	160	470										
T 29 R 16																
Sec. 6		310				330										
7		560		80												
8		190		450												
15				640												
16			590										50			
17		70		570												
18																
20			200													
22				640												
27				640												
28			145				15									
33											10					
34			600								40					
35				640												
UNS				590												
Sub Totals		1130	1535	4250		330	15				50		50			

TABLE 30 (Continued)

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Buffer Zone - Mountain Type - Wendel Amedee Area

Vegetation Types by Acres by Ownership Status

Location T 28 R 16	Grass (Acres)		Sagebrush-Grass (Acres)		Low Sage-brush (Acres)		Greasewood (Acres)		Saltgrass (Acres)		Salt Desert Shrub (Acres)		Bitter-brush (Acres)		Cropland (Acres)	Other
	P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	
Sec. 2				640												
4												70				
5				85								170				
10				45				240				355				
11				540								20				
Sub Totals				1310				240				615				
TOTALS	280	2200	1665	6900	160	800	15	240			50	615	50			

GRAND TOTAL = 12,975 Acres

TABLE 31

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Buffer Zone - Valley Type - Wendel Amedee Area

Vegetation Type by Acres by Ownership Status

Location T R	Grass (Acres)		Sagebrush-Grass (Acres)		Low Sagebrush (Acres)		Grease-wood (Acres)		Saltgrass (Acres)		Saltbrush (Acres)		Bitter-brush (Acres)		Cropland (Acres)	Water	Town Size (Acres)
	P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	State	
29 15																	
Sec. 9	30		130														
10	80														240		
11			190												250		
12			180														
13			20				80										
14							420								120		
15	220						420										
22							200										
23							560										
24			60				420										
25							90		500								
36							40		260								
Sub Totals	330		580				2230		760						610		
T R																	
29 16																	
Sec. 19			340				220										
29							160				100				60		
30							380								60	2790	
31							220		195								
Unsurveyed								150		185							
Sub Totals			340				980	150	195	185	100				120	2790	

TABLE 31 (Continued)

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Buffer Zone - Valley Type - Wendel Amedee Area

Vegetation Types by Acres by Ownership Status

Location T	R	Grass (Acres) P	V	Sagebrush-Grass (Acres) P	V	Low Sagebrush (Acres) P	V	Grease-wood (Acres) P	V	Saltgrass (Acres) P	V	Saltbrush (Acres) P	V	Bitter-brush (Acres) P	V	Cropland (Acres) P	Water State	Town Size (Acres)
28	16																	
Sec.	4							25										
	5							295		75								
	6							190		150								
	7							80		80						40		
	8							270								290		
	9			25				435					180					
	10			45				240					355					
	11			80	540						20							
Sub Totals				150	540			1535		305	20		535			330		
TOTALS		330		1070	540			4745	150	1065	205	100	535			1060	2790	7[illegible]

GRAND TOTAL = 9,770 + 2740 Acres of Water Surface

TABLE 32

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Buffer Zone - Island Area

Vegetation Types by Acres by Ownership Status

Location T R	Grass (Acres)		Sagebrush-Grass (Acres)		Low Sagebrush (Acres)		Grease-wood (Acres)		Saltgrass (Acres)		Saltbrush (Acres)		Bitter-brush (Acres)		Cropland (Acres)	Water	Town Size (Acres)
27 15	P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	State	
Sec. 1			60						120								
2			20				400		140								
3							480										
4							320										
5							380										
8							440										
9							320										
10							640										
11			170				470										
12			600						40								
13			160														
14			510				50										
15			405				75										
16			290				350										
17							380										
20							260		60				15				
21			250				20		30								
22			460						25								
23			70														
24			280				120										
25			210						140						200		
26									45								
27			105						80								
Sub Totals			3390				4705		680				15		200		

TABLE 32 (Continued)

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Buffer Zone - Island Area

Vegetation Types by Acres by Ownership Status

Location	Grass (Acres)		Sagebrush-Grass (Acres)		Low Sagebrush (Acres)		Grease-wood (Acres)		Saltgrass (Acres)		Saltbrush (Acres)		Bitter-brush (Acres)		Cropland (Acres)	Water	Town Size (Acres)
T R																	
28 15	P	V	P	V	P	V	P	V	P	V	P	V	P	V	P	State	
Sec. 28									90								
32							100										
33							280		230								
34							40		150								
35									45								
Sub Totals							420		515								
T R																	
27 16																	
Sec. 7			410						110								
8			95						160								
17			305						15								
18			640														
19			360														
20			90						30								
29			580						20								
30			460						20								
Sub Totals			2940						355								
TOTALS			6530				5125		1550				15		200		

GRAND TOTAL = 15,420 Acres + 4,246 Acres Water Surface

buckwheat (Eriogonum spp.) Phlox spp., Astragulus spp., popcorn flower (Plagiobothrys spp.), Gayophytum diffusum, Blephoropappus scaber, tumble mustard, fiddleneck (Amsinckia spp.), wild hyacinth (Brodiaea spp.), and bighead clover (Trifalium macrocephalum).

c. Greasewood (TABLE 29-32)

On the poorly drained, alkaline sites greasewood (Sarobatus vermiculatus) may be the only shrub present. On the less alkaline and better-drained sites rubber rabbitbrush, horsebrush, and big sagebrush are common shrub associates. Where the soils are both alkaline and saline the salt desert shrubs, spiny hopsage, shadscale (Atriplex confortifolia) and budsage (Artemisia spinescens) are also common.

Common half-shrubs and forbs in the greasewood type are seepweed (Suaeda torreyana), red sage (Kochia americana), Nitrophila occidentalis, pepperweed (Lepidium perfoliatum), and tansy mustard (Descurainia pinnata).

The principal grasses in the greasewood type are saltgrass (Distichlis stricta), Great Basin wildrye (Elymus cinereus) and squirreltail.

Great Basin wildrye was a major component of this type on the less alkaline sites in the climax stage. Heavy livestock grazing over a prolonged period of time has greatly reduced the abundance of this species.

d. Saltgrass (TABLE 29-32)

On some seasonally flooded alkali sites on the Honey Lake shoreline of the Island area saltgrass is the predominant vegetation. Rubber rabbitbrush has invaded some of the heavily grazed areas or sites subjected to other man-made disturbances. Greasewood is present but is not the dominant plant species.

On some of the moist, highly alkaline sites on the north side of Honey Lake, and southeast of Wendel, saltgrass and Nitrophila occidentalis are the primary plant species. Both of these species are strongly rhizomatous. Bullrushes (Scirpus nevadensis), arrowgrass (Triglochin maritima), and Puccinellia lemoni are also fairly abundant on the moist, alkaline soils.

e. Salt Desert Shrub (TABLE 29-32)

This type occurs in the KGRA of the Wendel-Amedee area. It is found on neutral, saline soils and saline-sodic soils, and generally occupies a topographic position slightly higher than the greasewood type. There is less than eight inches average annual precipitation in the area where this type occurs.

Shadscale, spiny hopsage, and budsage are the primary salt-tolerant shrubs in this type. Big sagebrush, rabbitbrush, and horsebrush are found in the sagebrush-desert shrub ecotone. Greasewood is often a major component of the desert shrub-greasewood ecotone.

Poverty weed (Iva axillaris), pepperweed, skeleton weed, and halogeton (Halogeton glomeratus) are the principal forbs in this type. Halogeton is a poisonous plant and is most abundant on disturbed areas where native shrubs and grasses have been removed such as roads and trails.

Squirreltail and Indian ricegrass (Oryzopsis hymenoides) are the principal grasses in this type, but saltgrass and Great Basin wildrye are found in the desert shrub-greasewood ecotone. Cheatgrass and Sandberg bluegrass are common grasses in the desert shrub-big sagebrush ecotone.

Very heavy early spring grazing has greatly reduced the perennial grass component of this type.

f. Cropland (TABLE 29-32)

There are small areas of irrigated crop and pasture land within the project area. The principal crops are alfalfa for hay and seed production and barley. Additional land is presently being cleared for crop production. Approximately 1,060 acres in the Wendel-Amedee area and about 655 acres on the Island area and within the project boundary have been cleared for farming. Only about 375 acres of crop and improved pasture land are included within a proposed leasing unit boundary.

Rare and Endangered Plant Species

No rare or endangered plant species have been discovered in the Wendel-Amedee or Island study areas. Reference has been made to the 1974 edition of the California Native Plant Society publication, "Inventory of Rare and Endangered Vascular Plants of California".

Domestic Livestock

Livestock grazing occurs on all potential geothermal lease units (See TABLE 33), and has been the principal historical use of the area.

Yearlong livestock grazing has been permitted on the Wendel-Amedee area but seasons of use are designated by certain specified portions of the Wendel-Amedee area (See TABLE 33). Currently, three ranchers are licensed to graze livestock on the national resource lands within this area.

Livestock grazing is permitted from the first of March through December on the Island area. Two ranchers are licensed to graze livestock on the national resource lands within this area.

Quantitative data for livestock use are shown in TABLES 33 and 34 for all lease units and buffer zones within the project area.

TABLE 33

AUM's BY POTENTIAL LEASING UNITS WITHIN STUDY AREA

Geothermal Areas & Potential Lease Units	Number of Operators	Number of Acres			AUM's Use or Qualifications	Season of Use	Class of Livestock	AUM's Production Range Survey
		Federal	State	Private				
Wendel-Amedee Area:								
Lease Unit No. 1	2	760			60	4/1 - 10/31	Cattle	60
Lease Unit No. 2	2	1,120			74	4/1 - 10/31	Cattle	74
Lease Unit No. 3	1	641			42	11/1 - 3/31	Cattle	42
Lease Unit No. 4	2			320	19	4/1 - 10/31	Cattle	19
Sub Totals					195			195
KGRA:								
Lease Unit No. 5	2	1,205			113	4/1 - 10/31	Cattle	106
Lease Unit No. 6	2	1,122			94	4/1 - 10/31	Cattle	94
Lease Unit No. 7	3	1,360			99	Yearlong	Cattle	99
Sub Totals					306			299
Island Area:								
Lease Unit No. 8	2	1,254			78	3/1 - 12/31	Cattle	78
Lease Unit No. 9	2	1,056			70	3/1 - 12/31	Cattle	70
Lease Unit No. 10	2	57		874	61	3/1 - 12/31	Cattle	66
Lease Unit No. 11	2	803			56	3/1 - 12/31	Cattle	56
Sub Totals					265			270
GRAND TOTALS		9,378		1,194	766			764

TABLE 34

AUM's FORAGE PRODUCTION BY POTENTIAL LEASING UNITS AND

BUFFER ZONES WITHIN STUDY AREAS

Geothermal Areas & Potential Lease Units	Number of Operators	Number of Acres			AUM's Use or Qualifications	Season of Use	Class of Livestock	AUM's Production Range Survey
		Federal	State	Private				
Wendel-Amedee Area:	3					Yearlong	Cattle	
Pot. Lease Units		6,208		320	494			494
Mt. Buffer Zone		10,755		2,220	755			755
Valley Buffer Zone		1,430		7,210	699			699
Subtotals		18,393		9,750	1,948			1,948
Island Area:	2					03/01 - 12/31	Cattle	
Pot. Lease Units		3,170		874	265			265
Island Buffer Zone		0		13,220	755			755
Subtotals		3,170		14,094	1,020			1,020
TOTALS (Wendel-Amedee + Island)		21,563		23,844	2,968			2,968
Cropland Outside Lease Units				1,310				
Water (Honey Lake)			6,985					
Townsite			70					
TOTAL ACRES		21,563	7,055	25,154				

TOTAL PROJECT AREA = Approximately 53,772 Acres

2. Wildlife

Wendel-Amedee Area and Island Areas

The Wendel-Amedee and Island Geothermal Study Area contains 47,875 acres. The area contains three distinct habitat types; the escarpment and rim rock areas, the benchlands, and flatlands, and the receding shoreline. (MAP 14) The escarpment covers 10,855 acres, the benchland and flats cover 29,680 acres and the wetlands cover 7,340 acres. These three broad habitat types are further subdivided into five environmental units as a result of vegetation and physiographic variations (TABLE 35).

a. Escarpment

Escarpment is characterized by steep cliffs, rocky outcrops and talus slides located in the Amedee Mountains. Vegetation is predominantly low sage (*Artemesia arbuscula*), cheatgrass (*Bromus tectorum*) and bluebunch wheatgrass (*Agropyron spicatum*). Rock ledges, crevices and rubble provide habitat for Golden Eagles, Prairie Falcons, Red-tailed Hawks, American Kestrels and Great Horned Owls, in addition to Cliff Swallows, Say's Phoebe, Canyon Wrens, Rock Wrens and Sage Sparrows. Small mammals include desert woodrats, bushy-tailed woodrats, deer mice and pocket mice. Reptiles consist of western swifts, side-blotched lizards and western rattlesnakes. The escarpment amounts to 23 percent of the total acreage in the study area.

b. The Benchlands and Flatlands

(1) Intermittent Stream. Intermittent stream habitat refers to the moist canyon bottoms, natural drainages and wet meadows that occur in the study area. In total, they account for 385 acres. Willows (*Salix*), wildrose (*Rosa spp.*), serviceberry (*Amelanchier alnifolia*), Mormon tea (*Ephedra viridis*), giant wildrye (*Elymus cinereus*), bluebunch wheatgrass (*Agrophyron spicatum*) and skeleton weed (*Lygodesmia spp.*) are common plant species.

The intermittent stream habitat is a low-grade riparian habitat but its importance as a source of "edge" shouldn't be underestimated. Mule deer, chukar, partridge and California Quail utilize this habitat during the spring and summer months. Meadow mice, ground squirrles and hares are important prey species.

(2) Sagebrush Habitat. The sagebrush community occupies 56 percent of the benchland and flatland area. The 16,735 acres are found in the Wendel-Amedee area while 12,200 acres occur on the Island. The Island is generally considered as a sagebrush-greasewood community or vice-versa, depending on the physical conditions of the site.

Sagebrush habitat is often monotypic with extensive stands of big sagebrush (Artemesea tridentata) and cheatgrass (Bromus tectorum). Other plant species occurring here include rabbitbrush (Chrysothomus spp.), horsebrush (Tetradymia spp.), spiny hot sage (Grayea spinosa).

Wildlife use in this habitat consists of mule deer, pronghorn antelope, Chukar Partridge, Mourning Dove, Western Meadowlark, Sage Thrasher, Sage Sparrow, Black-throated Sparrow, Lark Sparrow and Brewer's Blackbird. The California black-tailed hare, Nuttall's cottontail, kangaroo rat, pocket mice, grasshopper mice, antelope ground squirrel, and least chipmunk are important prey species.

(3) Greasewood Habitat. The flatlands are further subdivided into a greasewood type, which is characteristic of those areas high in exchangeable salts. It constitutes 37 percent of the Wendel-Amedee area, 51 percent of the Island and 26 percent of the total proposed study area. In acreage, there are 4,460 acres on the mainland and 8,100 acres on the island for a total of 12,560 acres.

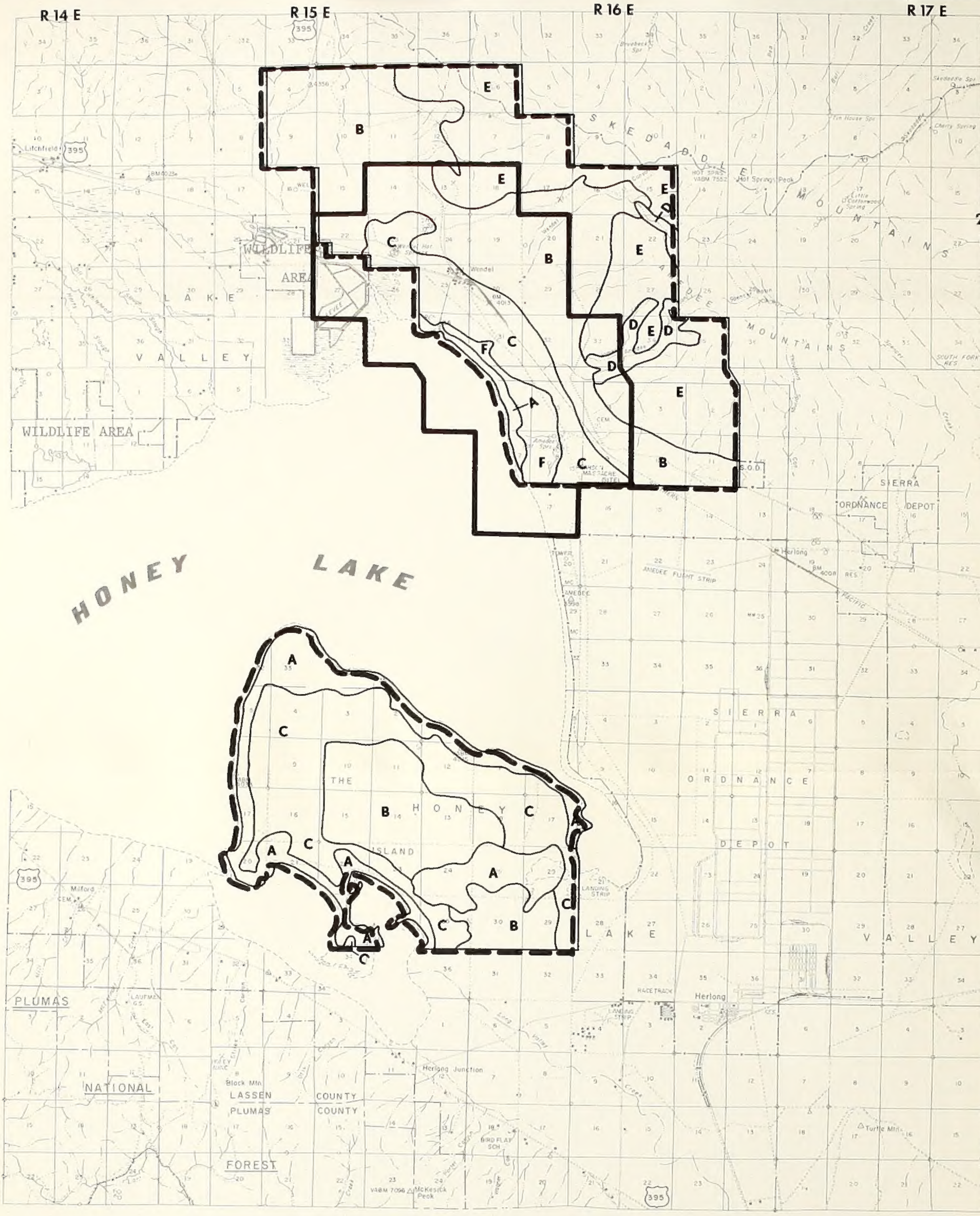
This vegetation type was found to consist primarily of greasewood interspersed with big sagebrush, horsebrush, hop sage, salt grass, and various forbs. Extensive monotypic stands of greasewood are found in close proximity to the town of Wendel and on the Island. Wildlife use in this habitat type is less obvious than in other types. California black-tailed Hare, Nuttall's cottontail, northern grasshopper mice, Great Basin pocket mice, least chipmunk, Sage Thrasher, Mourning Dove, Brewer's Blackbird and Western Kingbird are common inhabitants. Coyotes, badgers, Golden Eagles, Red-tailed Hawks and American Kestrels are common predators.

c. Receding Shoreline

This habitat is formed by the periodic fluctuation of Honey Lake. As the shoreline recedes, considerable wetland habitat develops. This habitat type is divided in respect to acreage between the "Island," which contains 3,130 acres, and the mainland where 4,210 acres exist. Receding shorelines represent 13 percent of the total study area. The vegetation is characterized by saltgrass flats interspersed with stands of rabbitbrush. Mudflats and sand dunes are also prevalent.

Cultivation of 1,065 acres of shoreline into alfalfa production has been accomplished in the vicinity of Amedee Hot Springs. This project is privately owned and utilizes water from the hot springs for irrigation purposes.

The receding shoreline habitat is important for all species of waterfowl and shorebirds inhabiting Honey Lake. (See Waterfowl section, below, for species list.)



LEGEND

Study Area Boundary

A— Receeding shoreline with Saltgrass and Rabbit brush

B— Big Sage and Cheatgrass with scattered Horsebrush, Hop Sage, Rabbit brush, Shadscale, and Giant Wild Rye.

C— Greasewood, Horsebrush, Hop Sage, Shadscale with Saltgrass and/or Cheatgrass.

D— Intermittant Stream, (Big Sage, Mormon Tea, Cheatgrass, Giant Wild Rye, Willow, Current, Wild Rose and Juncus)

E— Escarpment (Rimrock with Big and Low Sage, Cheatgrass)

F— Pasture (Seasonal)

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

ENVIRONMENTAL UNITS—WILDLIFE

MAP-14

SCALE: ½" = 1 MILE MT. DIABLO MERIDIAN

TABLE 35

VEGETATIONAL BREAKDOWN FOR WENDEL-AMEDEE AND ISLAND AREA

Habitat Type	Mainland	Island	Total	Percent
Escarpment	10,855	0	10,855	23%
Shoreline	4,210	3,130	7,340	15%
Intermittent Stream	385	0	385	1%
Sagebrush	12,200	4,535	16,735	35%
Greasewood	4,460	8,100	12,560	26%
	32,110	15,765	47,875	100%
	67%	33%		

Escarpment	10,855 Acres	23%
Flatlands	29,680 Acres	62%
Shoreline	7,340 Acres	15%

Each respective habitat type contains a variety of wildlife species that are adapted both physically and behaviorally to the conditions that exist there. Wildlife species should be regarded as subunits of each habitat type. Impacts on a habitat type should be assessed in terms of the effect it has on each subunit.

Mule Deer

Mule Deer are not abundant in the study area. Sightings have been confined to Wendel Canyon, Little Spencer Basin and Amedee Canyon. Estimates have it that between 10 and 20 animals summer in the Amedee area. (MAP 15) Winter deer estimates, migration routes and fawning areas have not been confirmed to data.

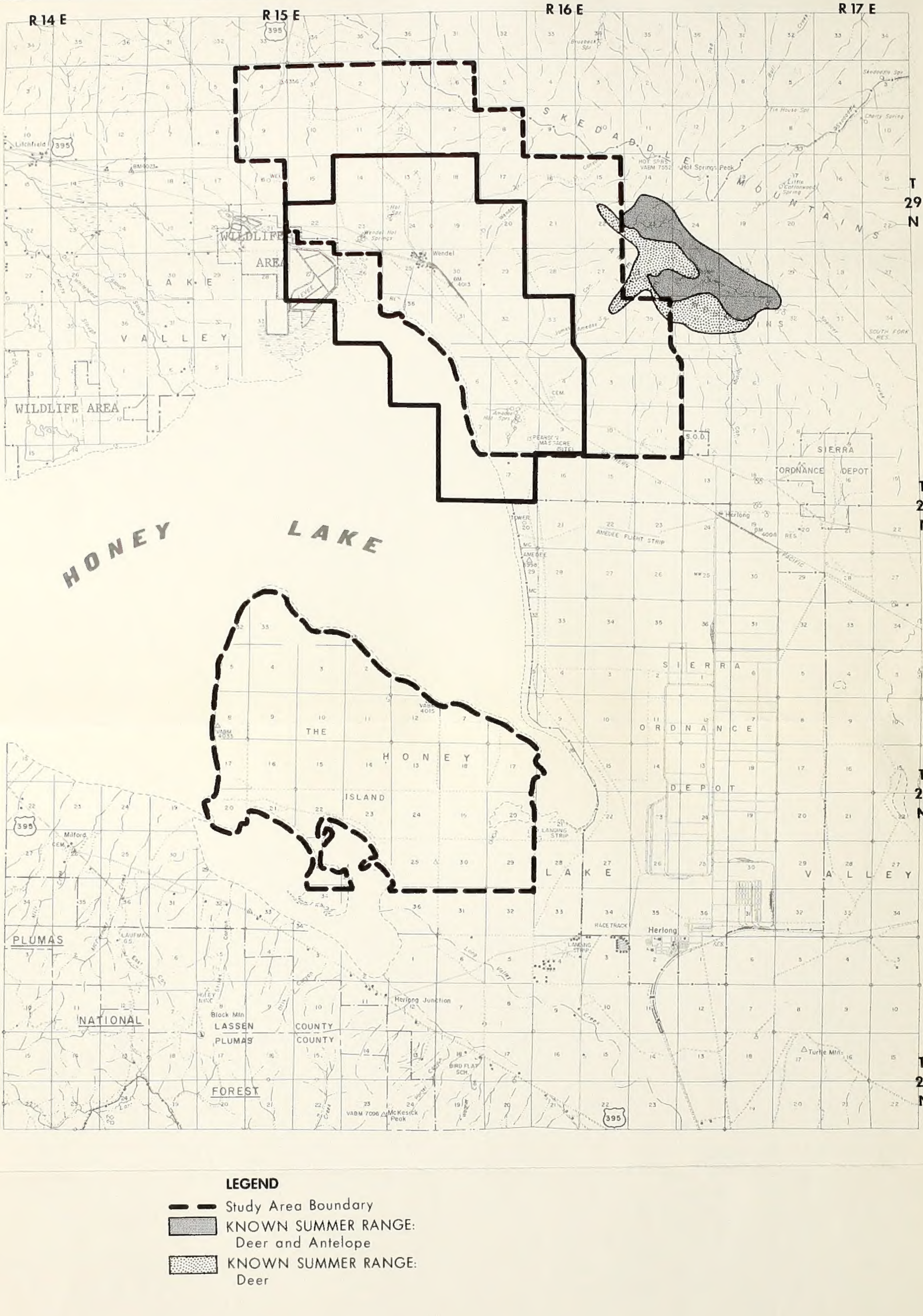
The most limiting factors affecting deer use in the area appear to be water and cover. The majority of the sightings have been in close proximity to the moist canyon bottoms and washes where a limited amount of semiriparian vegetation exists. These areas provide the only true edge available to deer in the immediate area. Fawns have been observed to bed down in this habitat. These areas should be considered of extreme importance to the well being of the deer in the area.

Seventeen deer were sighted in Wendel Canyon during March 1976. An aerial survey conducted on June 25, 1976, showed eight deer (two bucks, two does and four fawns) to be browsing along the semiriparian vegetation in Little Spencer Basin. Four deer were sighted on July 16, 1976, near Thousand Springs Canyon.

Pronghorn Antelope

The Honey Lake Geothermal Resource area receives at best only minimal use by pronghorn antelope. Only on one occasion have antelope been observed in the geothermal resource area (an antelope doe and kid, May 30, 1976). The California Department of Fish and Game (CDF&G) estimates that some 30 animals summer annually in Spencer Basin. An aerial survey flown on June 25, 1976, reveals seven antelope in the aforementioned area. Another survey on July 30 of the same year showed 11 animals in the basin area.

Winter census reports by the California Department of Fish and Game show that no antelope winter in the geothermal study area. (TABLE 36) No kidding grounds or migration corridors have been identified to date.



HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

SUMMER RANGE
DEER AND ANTELOPE

MAP-15

SCALE: ½" = 1 MILE   MT. DIABLO MERIDIAN

TABLE 36

ANTELOPE CENSUS TOTALS (Winter)

Year	Basic California Population	Skedaddle Mountain	Shaffer Mountain	Little Mud Flats
1954	1,850	7	73	128
1955	1,957	0	48	31
1956	2,338	17	0	385
1957	1,973	6	102	482
1958	2,165	0	0	371
1959	1,917	0	59	145
1960	1,780	9	265	171
1961	1,906	0	133	64
1962	2,269	25	0	410
1963	2,375	0	92	129
1964	2,618	0	27	66
1965	2,468	0	441	305
1966	2,735	0	228	658
1967	2,537	Unk.	Unk.	Unk.
1968	2,607	0	503	304
1969	2,870	0	234	273
1970	2,983	0	555	265
1971	3,800	0	504	304
1972	3,764	0	411	123
1973	4,357	0	178	825
1974	4,747	0	187	218
1975	4,109	0	71	381
1976	4,987	0	54	86

California Bighorn Sheep

The California Bighorn Sheep is declining in numbers in California. This premier big game species is gradually disappearing from marginal areas due to habitat loss associated with human development. A plan designed to reintroduce the species into native habitat is presently underway. (MAP 16) The Amedee Mountains have been proposed as a future release site by bighorn sheep specialist Richard Weaver of the California Department Fish and Game.

Archaeological evidence points out that the Amedees did indeed possess bighorn sheep. The fossil remains of a species identified as *Ovis canadensis* has been found in Tommy Tucker Cave, eight miles southwest of Wendel, California. Both aerial and ground reconnaisance have shown the area to possess all essential components of prime bighorn habitat. The carrying capacity of the Amedees have been estimated at some 30 animals.

The steep and rocky terrain, in addition to the remoteness of the area, are essential components of Bighorn habitat. The variable southern and western exposures, in addition to the prevailing wind patterns, will provide suitable winter habitat. Forage was deemed adequate and provisions for winter developments have been established.

Birds of Prey

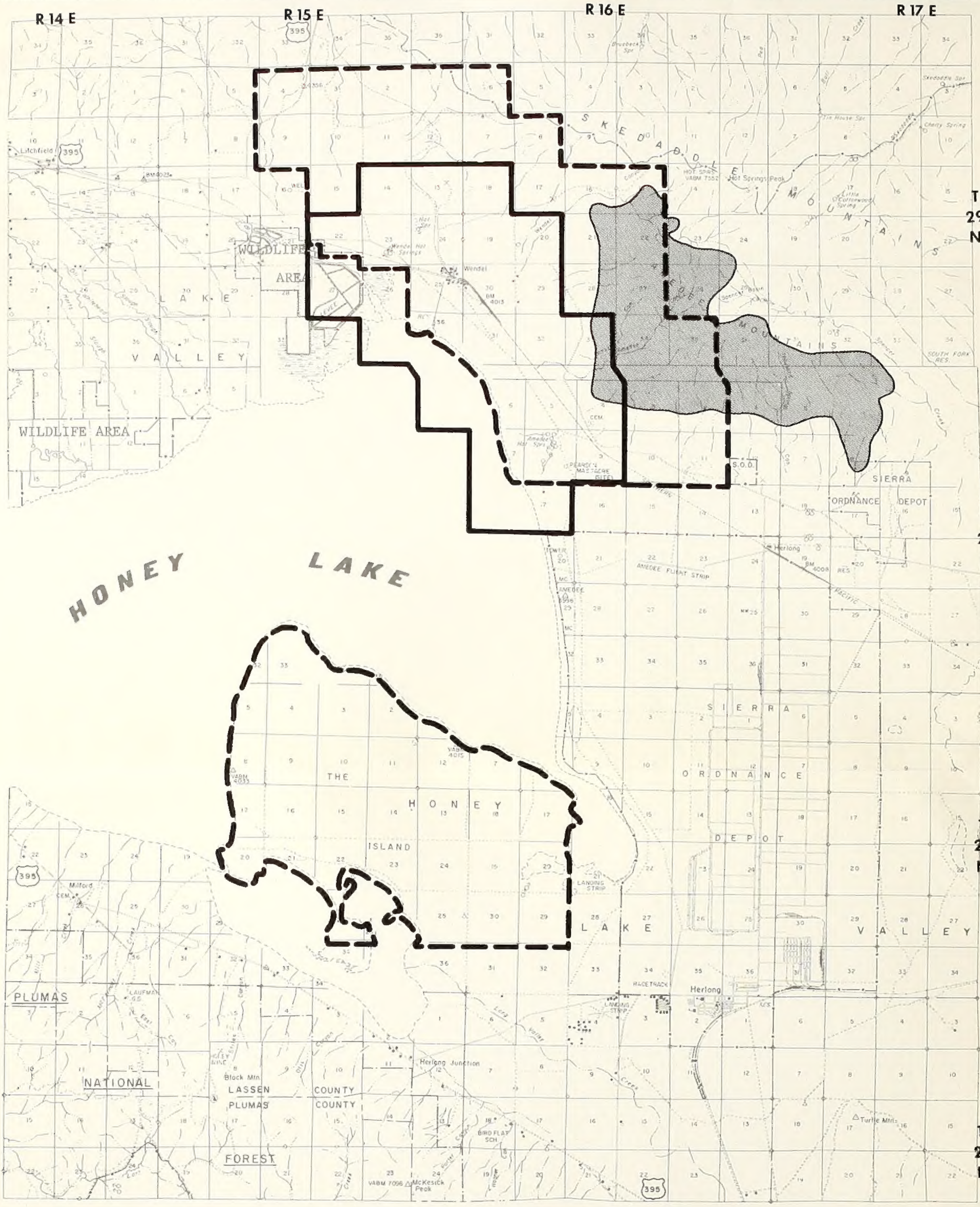
Birds of prey must rank as one of the leading wildlife values in the Honey Lake Geothermal Resource Area. Migrant as well as resident species utilize all five habitat types in varying degrees throughout the greater portion of the year. (MAP 17)

Seven species have been confirmed to actively breed in the Wendel-Amedee study area. These include: Prairie Falcon, Golden Eagle, Red-tailed Hawk, American Kestrel, Great Horned Owl, Long-eared Owl and Burrowing Owl. In addition to the above, Turkey Vultures, Short-eared Owls, Barn Owls and Marsh Hawks are found here but have not yet been confirmed to nest on the proposed geothermal lands.

Migrant species include: Bald Eagles, Furruginous Hawks, Rough-legged Hawks, Swainson's Hawks, and Merlins.

The highest degree of concentration is centered around the Amedee Mountains. The Amedees contain numerous canyons and cliff faces where adequate rock ledges and cavities exist. These combined with the availability of open space, a sufficient prey base and a history of remoteness and solitude, make the Amedees unique in possesing all the essential components necessary to support both the high concentration and diversity of raptors that exist presently.

The following is a list of those active breeders and their approximate numbers in terms of active pairs. In addition, reproductive success has been included when available.



LEGEND

Study Area Boundary

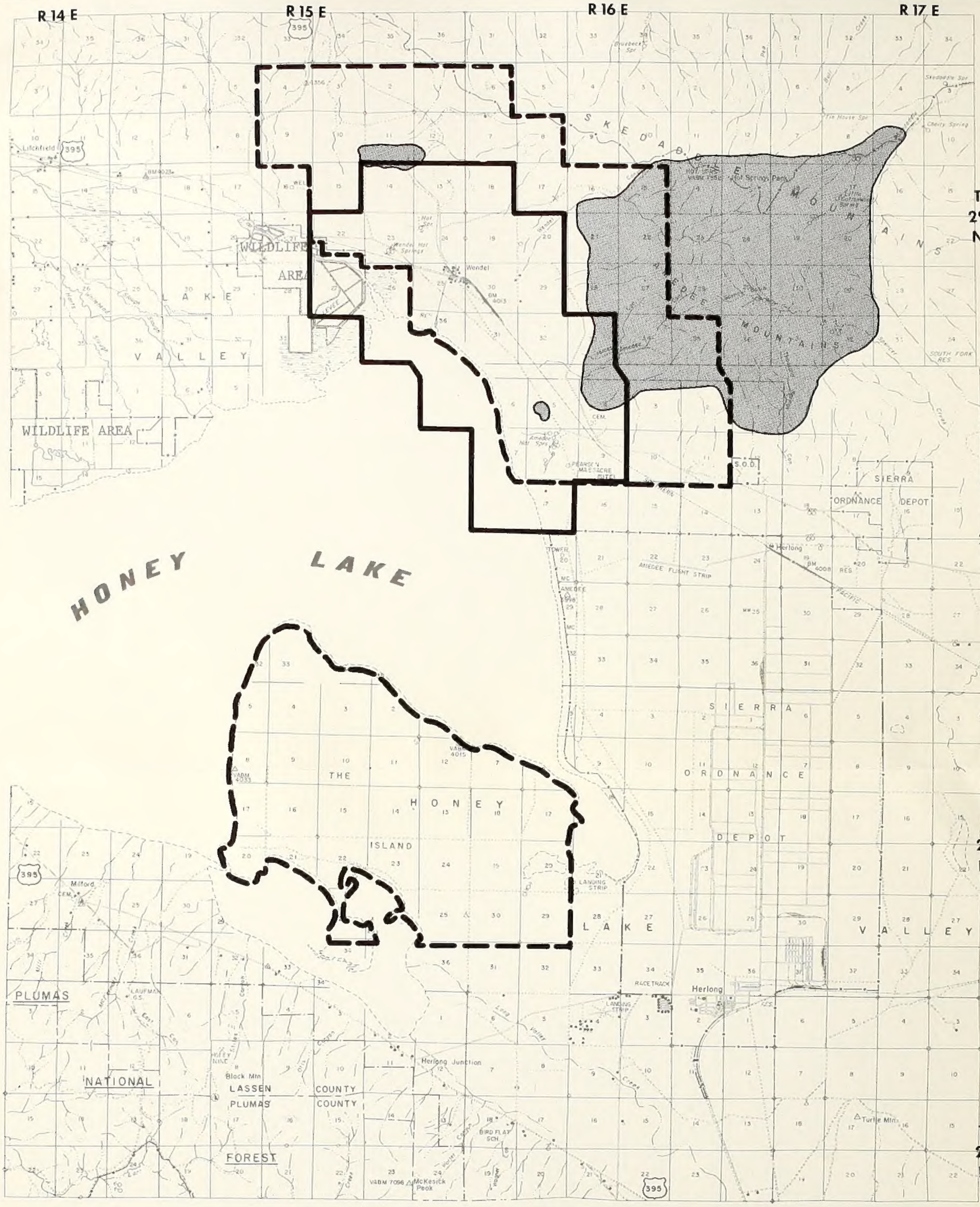
Proposed Bighorn Sheep Range

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

PROPOSED BIGHORN SHEEP RANGE

MAP-16

SCALE: ½" = 1 MILE   MT. DIABLO MERIDIAN



LEGEND

- Study Area Boundary
- Area of high density Raptor Nesting Sites

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

RAPTOR NEST SITES

MAP-17

SCALE: ½" = 1 MILE   MT. DIABLO MERIDIAN

Golden Eagles

Three pairs currently exist in the Amedee Mountains. One pair has nine alternate eyries, as well as an active eyrie. Only one pair failed to fledge the accustomed two young in 1976. Investigation revealed that the carcass of an adult eagle below an eyrie. The cause of death is unknown at this time. The death of this adult bird resulted in the site being inactive this year.

Prairie Falcons

Three prairie falcon eyries were active in 1976 and all fledged young. Accurate reproductive data are unavailable. Average production per reproductive pair in California is 3.2. Two pairs nested in rock cavities while the third occupied an abandoned eagle's nest.

Red-tailed Hawks

Four Red-tailed Hawk eyries were identified within the geothermal resource area. Three of the sites produced two young each while reproductive data on the fourth pair are lacking. Three of the confirmed nests were on rock ledges while the fourth was constructed on a power pole.

Great Horned Owls

Three active Great Horned Owl eyries have been identified to date. Great Horned Owls occupy Red-tailed Hawk nests and/or eagle nests prior to the arrival of the original inhabitants. Reproductive data are lacking for all but one pair. This particular pair fledged the average two birds.

Long-Eared Owls

One pair of Long-Eared Owls were located in the study area. An abandoned nest containing four eggs was located in a rock cavity. Another nest was located in the same canyon and most probably represented a second nesting attempt. This second nest was located in a dense mountain mahogany where a Black-billed Magpie nest had been utilized.

American Kestrels

American Kestrels or Sparrow Hawks are cavity nesters. In all five cases rock cavities were selected for nesting. These sites were generally located near canyon mouths or cliff faces where favorable views were afforded.

Burrowing Owls

This unique species of owl favors abandoned small mammal burrows for its nest site. Four nesting burrows have been identified to date. These sites have generally been located in flat sagebrush or greasewood areas. No reproductive data are available.

Threatened and Endangered Wildlife

The Federal Endangered Species Act of 1973 recognizes one species in the Honey Lake Geothermal Area as being in need of protection. The Southern Bald Eagle, a regular winter visitor to Honey Lake was sighted on 10 occasions during the winter of 1975-76. No mammals, fish or invertebrates in danger of extinction or classified as "threatened or endangered" are known to occur in the study areas.

Peter H. Bloom (Wildlife Biologist, BLM), in a personal communication on November 23, 1976, gives validity to the theory that Bald Eagles feed on crippled waterfowl. At Tule Lake National Wildlife Refuge Bloom witnessed Bald Eagles feeding on waterfowl on 63 occasions.

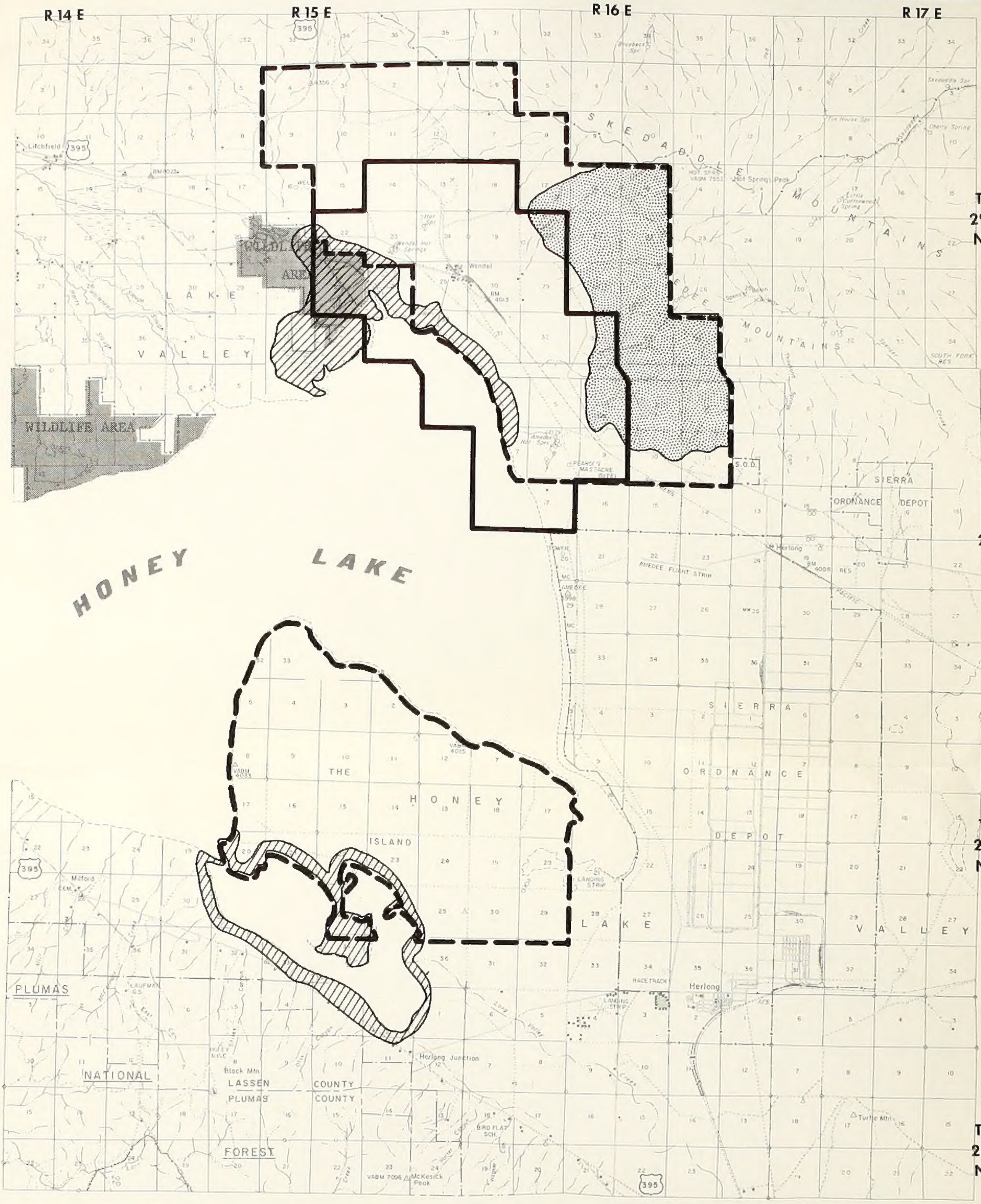
Consequently any action which will impair the productivity and/or the general condition of the habitat at Honey Lake for waterfowl will impair the winter feeding habits of the Bald Eagle.

The National Audubon Society recognizes eight species as being involved in noncyclic population declines. This includes the Western Burrowing Owl, Marsh Hawk, American Kestrel, Double-crested Cormorant, White Pelican, Western Grebe, Black-crowned Night Herons and White-faced Ibis. All of the aforementioned species nest in the study areas.

Waterfowl

Honey Lake is one of the richest areas in northeastern California in terms of waterfowl habitat. The Honey Lake Wildlife Area (operated by the California Department of Fish and Game), in addition to private hunting and agricultural concerns, enhances and maintains valuable wetland habitat. Grain fields and pastures appeal to the grazing instincts of many migrating species while water impoundments, reservoirs and irrigation canals provide a valuable source of water and cover especially during drought conditions. (MAP 18)

Some 12 species of ducks and geese nest at Honey Lake (TABLES 37 and 38). During peak migration periods in the spring and fall large numbers of Whistling Swans, Great Basin Canada Geese, Snow Geese and White-fronted Geese congregate at Honey Lake. (No estimates of migrating waterfowl are available at present.) Mallards, Pintails, Gadwalls, Shovelers and Cinnamon Teal migrate through as well.



LEGEND

- Study Area Boundary
- Chukar Range
- Waterfowl and Shorebird Production Area
- Wildfowl Management Areas

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

WATERFOWL AND UPLAND GAME BIRDS

MAP-18

SCALE: ½" = 1 MILE MT. DIABLO MERIDIAN

TABLE 37

WATERFOWL NESTING SURVEY

HONEY LAKE VALLEY - LASSEN COUNTY

(Honey Lake, Levett Lake, Hartson Reservoir, Fleming Unit & Rest of Valley)

SPECIES	1965	1966	1967	1968	1969	Avg. 1960-1969	No. Per Year 1949-1959
CANADA GEESE							
Singles	No Flight	No Flight	No Flight	No Flight	No Flight	No Flight	52
Pairs							237
Groups							622
Total							1,200
Adults w/Young	299	155	138	150	223	147	237
Young	754	330	222	389	580	345	485
Groups	172	164	202	192	542	186	119
Total	1,225	649	562	731	1,345	678	1,021
DUCK PAIRS							
Mallard	620	698	418	828	886	563	600
Pintail	337	421	332	619	833	375	293
Gadwall	180	168	127	300	282	155	118
Cinnamon Teal	163	127	117	145	181	119	137
Redhead	154	53	54	93	168	125	161
Ruddy Duck	23	18	37	40	9	27	21
Lesser Scaup	10	4	35	29	2	16	13
Bufflehead	-	-	1	-	-	-	-
Shoveler	59	49	75	67	37	48	54
American Widgeon	15	3	5	7	15	6	1
Merganser	-	-	4	-	1	1	-
Canvasback	-	-	1	-	-	1	1
Green-winged Teal	-	-	-	-	-	-	4
Blue-winged Teal	-	-	-	-	-	-	1
Wood Duck	-	-	-	-	-	-	-
Others	RN 1	-	RN 2	-	-	-	5
Total Duck Pairs	1,562	1,541	1,208	2,128	2,414	1,434	1,409
COOT PAIRS	250	198	219	168	128	181	369
CRANES							
Groups	-	-	-	-	-	-	-
Pairs	1	2	-	-	2	-	-
Singles	-	1	-	1	-	-	-
SWANS	-	-	-	-	-	-	-

Source: California Department of Fish and Game.

TABLE 38

WATERFOWL NESTING SURVEY

HONEY LAKE VALLEY - LASSEN COUNTY

(Honey Lake, Levett Lake, Hartson Reservoir & Rest of Valley)

SPECIES	1970	1971	1972	1973	1974	1975	1976
TOTAL CANADA GEESE FIRST WEEK OF JUNE							
Adults w/Young	248	292	273	333	258	214	94
Young	364	452	403	456	571	457	17
Groups	667	991	727	1,014	1,572	1,138	465
Total	1,279	1,735	1,403	1,803	2,401	2,809	576
DUCK PAIRS							
Mallard	937	204	834	638	457	449	553
Pintail	340	55	339	559	196	152	145
Gadwall	242	141	348	300	213	164	241
Cinnamon Teal	188	78	125	129	132	110	190
Redhead	107	86	96	106	147	130	54
Ruddy	19	14	14	10	29	37	21
Shoveler	48	21	24	11	45	10	36
Lesser Scaup	26	20	5	7	13	14	6
Bufflehead	-	-	-	-	-	-	-
American Widgeon	10	1	7	2	7	5	7
Merganser	-	1	1	-	-	-	1
Canvasback	-	-	-	2	-	-	-
Green-winged Teal	-	1	-	-	2	-	-
Blue-winged Teal	2	-	-	-	-	-	-
Wood Duck	-	1	-	-	-	-	-
Ring Necked	-	-	2	-	3	-	1
Others	-	-	-	-	1	-	-
Total Duck Pairs	1,919	623	1,795	1,764	1,245	1,071	1,255
COOT PAIRS	222	288	131	169	135	245	395
SANDHILL CRANES							
Groups	-	-	3	-	-	5	-
Pairs	-	-	-	1	-	-	-
Singles	1	-	-	1 wkly	-	-	-
SWANS	-	-	-	-	-	-	-

Source: California Department of Fish and Game.

Within the geothermal resource area three prime concentration areas have been located. The mouth of Long Valley Creek and its two adjacent coves appeal to migratory waterfowl. During March of 1976 300 Whistling Swans, 100 Pintails, 50 mallards, 50 shovelers and approximately 100 various teal were observed on one afternoon. This area is intermittent in nature and was dry during the fall migration.

The mouth of the Susan River is extremely important as it often provides the only source of water to the lake. Large flocks of Swans, Geese, Ducks and various shorebirds congregate here especially during late summer months.

The lake's northern shoreline has been reported to be a waterfowl production area by the California Department of Fish and Game (F. Kozlik, 1976, personal communication). Pintails, mallards Redheads and Cinnamon teal converge on this area during the spring.

Shorebirds

Shorebird habitat is often co-existent with that of waterfowl. Due to the national and international importance of migratory shorebirds (as evidenced by existing migratory bird treaty acts with Canada and Mexico), habitat protection for these migrants becomes paramount. White Pelicans (5,000 - 10,000), White-faced Ibises and Northern Long-billed Curlews are birds considered as "Status Undetermined" by the U.S. Department of Interior. In addition to these three species, the Double-crested Cormorant, the Western Grebe, the Black-crowned Night Heron and the American Bittern are considered in some form of noncyclic population decline by the National Audubon Society. All of the aforementioned species nest at Honey Lake.

In addition to the above species, the following species have been observed at Honey Lake.

1. Eared Grebes
2. Horned Grebes
3. Great Blue Herons
4. Common Egrets
5. American Avocets
6. Black-necked Stilts
7. Killdeers
8. Common Snipes
9. Spotted Sandpipers
10. Willets
11. Long-billed Dowitchers
12. Wilson's Phalarope
13. Northern Phalaropes
14. California Gulls
15. Ring-billed Gulls
16. Forester's Terns

Song Birds

Song bird diversity in the Honey Lake Geothermal Resource Area is generally low. Twenty-five species have been identified to date. This low diversity can best be attributed to the overall monotypic vegetational conditions that exist throughout the greater portion of the resource area.

Intermittent stream courses provide the best habitat available. Intermittent water supplies, succulent and/or green vegetation and dense brush cover can be attributed to the rise in passerine populations.

The following is a listing by habitat types of resident species known to occur.

Greasewood Habitat	Escarpment
Sage Thrasher	*Canyon Wren
Sage Sparrow	Rock Wren
Western Meadowlarks	*Say's Phoebe
Brewer's Blackbird	*Violet-green Swallow
Loggerhead Shrike	
*Black-bellied Magpie	

Sagebrush Habitat	Intermittent Stream
*Sage Sparrow	Spotted Towhee
Brewer's Sparrow	Green-tailed Towhee
Lark Sparrow	*Robin
*Black-throated Sparrow	Ruby-crowned Kinglet
Sage Thrasher	*Common Bushtit
Brewer's Blackbird	White-crowned Sparrow
Western Meadowlark	Rufus-crowned Sparrow
*Black-bellied Magpie	Savanna Sparrow
*Loggerhead Shrike	Oregon Junco
Common Nighthawk	Fox Sparrow
	Hermit Thrush

*Species known to nest in that habitat type.

Upland Game Birds

Chukar Partridge, California Quail and Mourning Dove are the most common upland game birds in the geothermal resource area. (MAP 18) Although Sage Grouse have been observed outside of the study area, no evidence has been found to confirm their use of this area at present. They therefore have been excluded from this report.

The Wendel-Amedee study area contains an abundant population of Chukar Partridge, moderate numbers of Mourning Dove and a remnant population of California Quail. No population estimates have been compiled to date on any of the upland game speices.

In the Wendel-Amedee study area, upland game birds are found primarily where water is available. This is especially true during hot summer months when seasonal or intermittent water sources have been exhausted. Quail and chukar alike restrict their travel radius when water is limited. Doves, for the most part, have a larger daily range due to their superior flying ability. Wendel Canyon, Amedee Canyon and the stringer meadows found in Little Spencer Basin are focal points for chukar and quail during late spring and summer. Doves, for the most part, are distributed throughout the area.

Upland game in general should be viewed as one of the more important wildlife values in the study area. From the standpoint of land use, the hunting of upland game, especially chukar, is economically important to the area and very gratifying in terms of hunting pleasure.

Chukar Partridge

The success of Chukar Partridge in the Wendel-Amedee area can be attributed to the bird's preference for arid, mountainous areas. The rocky outcrops, talus slides and cliffs found in the Amedee Mountains provide nesting, loafing and escape habitat necessary for the birds' survival.

During April of this year, chukar calls could be heard along the entire extent of the Amedee Mountains. This widespread dispersal occurs as a result of the male's intolerance of other males during the mating season. Individual birds were observed calling from atop rock boulders and from canyon walls in Wendel Canyon. First Canoyn (Sec. 28, T.29N, R.16E.), Second Canyon (Sec. 28, T.29N., R.16E.) and in James and Amedee Canyons. Small groups of chukar were also observed and heard on the foothills in Section 21, T.29N., R.16E., in the rocks above Wendel Canyon Road (Sec. 17, T.29N., R.16E.) and along the face of the Amedees from Second Canyon to James Canyon.

During June and July larger flocks of chukar, containing five to 24 birds, were observed along the stringer meadows in Little Spencer Basin (Secs. 22 and 23, T.29N., R.16E.) and along the drainages leading to the mouth of Amedee Canyon. These particular areas furnished the birds with a source of green forbs, grasses, fruits, insects and water.

Water has a great effect on the distribution of chukars, especially during hot summer months. An examination of the watering facilities in the Wendel-Amedee area has shown that chukar utilize the natural springs and seeps to a greater degree than the artificial watering facilities. During these summer months, authorities believe that chukar seldom are seen more than one mile from water. This lends further support to the importance of these meadows and moist canyon bottoms, particularly in this geographical area where water is a critical limiting factor.

Chukar hunting in the Wendel-Amedee area is considered to be one of the leading land uses.

California Quail

Remnant populations of California Quail have been observed in the Wendel-Amedee study area. Quail inhabit areas were water, dense cover and herbaceous vegetation are suitably interspersed. In the Wendel area, water is by far the most limiting factor affecting quail populations. All observations have been restricted to moist canyon bottoms, intermittent streambeds, springs meadows and areas surrounding human habitation.

Areas suitable to quail include: Wendel Canyon, Little Spencer Basin, and those areas in close proximity to the town of Wendel. All quail observations in the Wendel-Amedee study area were made during April and May of 1976. Since this period, no quail observations have been made in the geothermal study area.

A California Fish and Game representative has reported seeing large coveys of quail along Highway 320 near the town of Wendel and along the flatlands adjacent to the Amedee Mountains southeast of Wendel (Ken Conrad, personal communication).

Mourning Dove

The Mourning Dove is found throughout the Honey Lake Geothermal Resource Area. Its versatility in terms of nesting requirements, feeding habits and water utilization make it the most widely distributed of all upland game birds.

Mourning Dove have been observed on Honey Lake Island in addition to the Wendel-Amedee area. They have also been observed in a variety of habitats including sagebrush, greasewood, intermittent streams, receding shorelines and escarpments. Nests have been located in the greasewood and escarpment habitats.

Mourning Dove are migratory in this part of their range. Fall flocking begins in late August with juveniles preceding the adults south. They generally arrive back in late April and May, depending on weather and temperature conditions. There are no known areas where dense populations of doves are found in the geothermal area.

Small Mammals

Nineteen species of mammals have been identified to date in the Wendel-Amedee study area. These species differ in respect to size, habitat preference, feeding habits and activity patterns.

Carnivores

The coyote is the most numberous predator in the study area. Actual field sightings and identification of scats and tracks indicate that coyotes inhabit all vegetation types. Coyotes are omnivorous as well as opportunistic in terms of prey. Rabbits, mice, chipmunks and ground squirrels are favored prey. Coyotes are generally nocturnal but tend to venture out during daylight hours when compelled to do so.

The badger is generally considered to be a diurnal predator. It is superably equipped with long claws to dig out its favorite prey--ground squirrels, rats, mice, gophers and chipmunks. Badger activity is suggested by the presence of large, freshly dug burrows. Only one observation of a badger has been made in the Wendel-Amedee area. At that time, the animal was observed entering a stand of greasewood along Highway 320.

The California Black-tailed Hare

The Black-tailed Hare is a common inhabitant of the greasewood and sage-brush habitats. It is herbivorous, feeding on most available grasses, forbs and shurbs. Black-tailed Hares are a valuable link in the food chain of mammalian as well as avian predators. No estimates have been made to date.

Nuttall's Cottontail

This cottontail is not as numerous as the Black-tail. It has been observed in greasewood and sagebrush stands and also in close proximity to rubble-strewn areas. It too is herbivorous, feeding mainly on grasses and sagebrush.

Yellow-bellied Marmots

Marmots have been observed primarily in distributed areas where rocks have been upheaved. Marmots prefer grass, clover, vetch and stonecrops.

Rodents

Thirteen species of rodents have been identified to date. This population contributes significantly to the ecology and the overall biomass of each environmental unit or habitat.

Rodents are important to man for a number of reasons.

a. They are in direct competition with livestock for forage.
b. They are an important seed dispersal mechanism.
c. They are an important buffer between predators and livestock.

The following is a listing of the various species and their relative composition for each environmental unit.

TABLE 39

SPECIES TYPE		RELATIVE COMPOSITION
Greasewood		
1. Ord's Kangaroo Rat		33%
2. Least Chipmunk		30%
3. Deer Mouse		22%
4. Great Basin Pocket Mouse		15%
	TOTAL	100%
Sagebrush		
1. Deer Mouse		46%
2. Great Basin Pocket Mouse		21%
3. Western Harvest Mouse		21%
4. Antelope Ground Squirrels		4%
5. Least Chipmunk		4%
6. Great Basin Kangaroo Rat		2%
7. Ord's Kangaroo Rat		2%
	TOTAL	100%
Intermittent Stream		
1. Deer Mouse		71%
2. Long-tailed Meadow Mouse		29%
3. Great Basin Pocket Mouse		8%
	TOTAL	100%
Escarpment		
1. Desert Woodrat		
2. Bushy-tailed Woodrat		
3. Canyon Mouse		
4. Deer Mouse		
Receding Shoreline		
1. No trapping conducted.		

Reptiles and Amphibians

Ten species of reptiles and amphibians are known to inhabit this study area. These species may be divided into three main groups: frogs, reptiles and snakes.

Frogs

The Pacific Treefrog can be observed around springs, reservoirs, and intermittent water sources. Due to the lack of water in many areas, the species' distribution and abundance is restricted.

Lizards

The Western Fence Lizard or swift is the most common lizard in the study area. It may be frequently observed on rocks and canyon walls, in addition to fence posts, lumber piles and buildings.

The Collared Lizard is a common inhabitant of the Wendel-Amedee area. It prefers rock strewn areas where vegetation is sparse. The Collared Lizard may be found in canyons, rock gullies, and mountain slopes.

The Leopard Lizard has been observed in Greasewood and Sagebrush stands. Preference is for sand or gravel sites with only scattered stands of low grasses and forbs.

The Great Basin Whiptail has been observed among Greasewood and Desert Saltbrush stands in the Wendel-Amedee area. This species has habitat preferences similar to the Leopard Lizard.

Northern Side Blotched Lizards have currently been observed in several canyons. This lizard prefers sandy washes where scattered rocks and low-growing brush prevail.

Snakes

The Great Basin Gopher Snake has been located in various canyons where grasses and brush are abundant. It feeds on rodents, birds, eggs and occasionally lizards. Second Canyon and Wendel Canyon contain Gopher Snakes.

The Western Yellow-bellied Racer is an inhabitant of the intermittent streambeds and stringer meadows where it hunts lizards, small mammals and insects. Observations have been made in Wendel Canyon.

The Stripped Whip Snake prefers the rocky stream bottoms, both permanent and intermittent. This species has been recorded in Amedee Canyon.

The Western Rattlesnake (Great Basin) has not been observed in the study area although various skins have been found.

Fisheries

According to the State Resources Agency of California, there are indicated fishery values in the lower Susan River, ponds and canals within the Honey Lake Wildlife Area (Fleming Unit), and various agricultural waterways. These waters support such gamefish as largemouth bass, brown bullhead, black crappie, Sacramento perch, and bluegill and pumpkinseed sunfish. Principal nongame fish are redside shiner, Lahontan sucker, and speckled dace. Honey Lake can support limited populations of game and nongame fish in springs adjacent to the Honey Lake Wildlife Area (Fleming Unit) and along the east and southwest margin of the lake. Size of the fish populations in the lake fluctuates depending on water quantity and quality. Fish species composition within the lake is not well known but fishermen reportedly caught brown bullhead within the lake in the early 1970's before it went dry. Other gamefish found in the lower Susan River have not been reported from the lake.

Nongame species supply a prey base for those fish-eating species of birds inhabiting the lake. Intermittent periods of drought result in large-scale die-offs.

C. Human Interest Components

1. Aesthetics

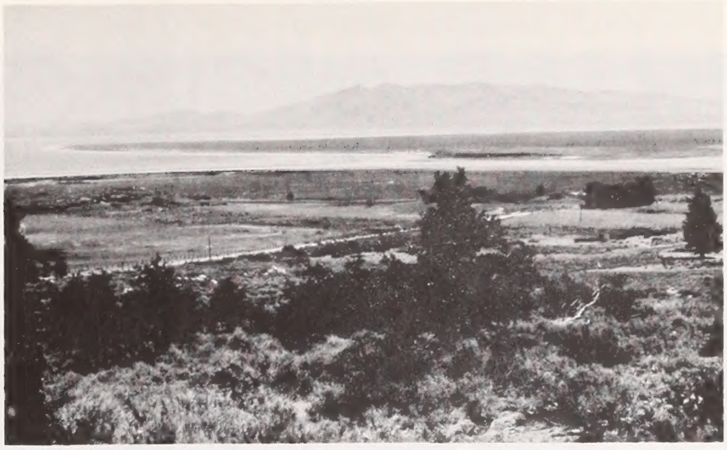
Visual Overview

To provide a visual overview of the study area, identifiable landscape features have been catalogued with a photograph and a brief description of location, landform, intrusions and distinctive features (Figures 14 through 17). MAP 19 indicates the location of each landscape feature. The visual cones on the map indicate the location of orientation of each photograph.

Concepts and Study Methodology

A three-phase inventory process was used in this aesthetics study: (1) an evaluation of scenic quality; (2) an evaluation of visual sensitivity; and (3) a determination of visual prominence zones. Also considered were the types and numbers of viewers at various locations.

Scenic quality is a function of the major landscape features (landform, vegetation, and water), the visual characteristics of those features, the extent to which they have been modified by human intrusion, and the relative uniqueness of these features within the region. This phase of



HONEY LAKE VALLEY

LOCATION: From Susanville southeast of Doyle and extending into Nevada to Sand Pass.

LANDFORM: Broad desert valley bordered by desert mountains, the Sierras, and including Honey Lake.

INTRUSIONS: Several major highways and railroad lines, undeveloped subdivision roads, motorcycle trails, Sierra Army Depot and accompanying storage facilities and roads, and residences associated with valley towns, ranches and subdivisions.

DISTINCTIVE FEATURES: Extensive valley some 45 miles long and 15 miles in width, surrounded by mountain ranges and peaks. Honey Lake is centered in the valley with Susanville and its nearby residential and ranching areas in the western portion, and Sierra Army Depot and large alkali flats occupying much of the eastern valley.

FIGURE 16

SKEDADDLE MOUNTAINS

LOCATION: East of the town of Wendel and northeast of Honey Lake.

LANDFORM: Mountainous with many and varied topographic features including steep cliffs, canyons and peaks up to 7,574 feet, some 3,500 feet higher than the valley floor.

INTRUSIONS: No internal intrusions. On the south and southeast slopes are gravel pits and motorcycle use areas along the Wendel-Sand Pass Road and the Sierra Army Depot test firing area.

DISTINCTIVE FEATURES: Due to the vast undeveloped acreage, scenic and wildlife values, and archaeological resources, this area (including the Skedaddle and Amedee Ranges and Spencer Basin) was recommended in the Cal-Neva Management Framework Plan for designation as a primitive area. Under BLM's Organic Act, the area will now be handled under interim management guidelines and treated as a Roadless Study Area with the potential for eventual Wilderness designation.

FIGURE 17

VIEWLAND

LOCATION: West of Skedaddle Mountains, north of Wendel and bisected by U.S. Highway 395.

LANDFORM: Low rolling hills with several distinct drainages.

INTRUSIONS: Transmission lines, Southern Pacific Railroad, extensive gravel pits, U.S. Highway 395 and several unimproved roads.

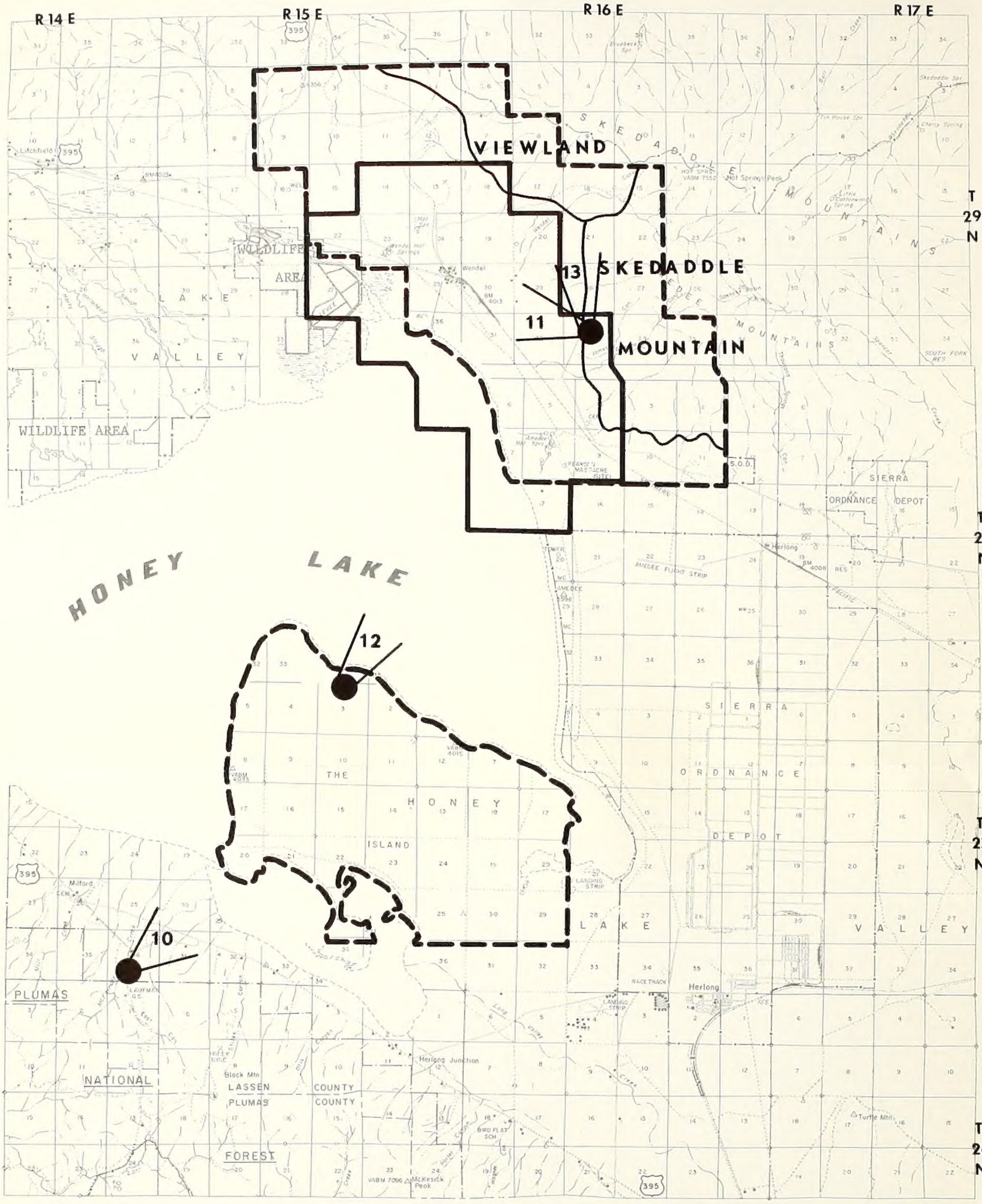
DISTINCTIVE FEATURES: First views of Honey Lake Valley, when traveling from the north, are provided from Viewland as well as excellent vantage points for the forested Sierra peaks. Site of passage of several historic pioneer trails.

the study is an evaluation of the relative inherent scenic quality of the physical landscape without consideration of the potential viewer. The BLM's Recreation Information System methodology for rating scenic quality was used for this portion of the aesthetics evaluation.

Visual sensitivity is a measure of the sensitivity of the viewer as well as a measure of the sensitivity of the land being viewed. The key determinants of visual sensitivity include; (1) highway and road-use volume; (2) recreation-use volume; (3) general social attitudes toward intrinsic resources (potential wilderness, natural and cultural areas); (4) community land uses, relationships and attitudes; and (5) relationships and plans of other governmental agencies.

Determination of visual prominence zones is important because man-introduced features (visual intrusions) are visible to greater or lesser degrees depending upon the type of topography they are situated in. For the purposes of this study, three visual prominence zones have been identified: The foreground-middleground, and the background and the area seldom seen.

After the aesthetic inventory has been compiled and mapped, the visual resource management classes are determined by overlaying the scenic quality, visual sensitivity and visual prominence maps. The results are then analyzed to determine the visual resource management classes.



LEGEND

Study Area Boundary

Landscape Features Boundaries

Photo Cone

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

LANDSCAPE FEATURES

MAP-19

SCALE: ½" = 1 MILE MT. DIABLO MERIDIAN

Inventory results

The results of the aesthetics inventory are presented on MAPS 20 through 23.

Scenery Quality Classes B and C (MAP 20) were identified, with the Skedaddle Mountains and Honey Lake Valley rated as Class B and the Viewland area as Class C. For a more detailed discussion of Scenic Quality Classes and Visual Resource Management Classes, refer to APPENDIX 5.

Visual Sensitivity Levels (MAP 21) were identified as high in the areas near U.S. Highway 395 in both the Wendel-Amedee and the Island segments. The Skedaddle Mountains were also identified as high sensitivity. The Viewland area was rated as low sensitivity, with the remainder of both the Wendel-Amedee and the Island rated as medium sensitivity.

All portions of the study area were identified into Visual Prominence Zones (MAP 22) with the land facing Highway 395, the Skedaddle Mountains and the Wendel-Sand Pass Road area falling into foreground-middleground. The remainder of the Island and the Viewland area were considered as background areas (TABLE 40).

Utilizing the three previous maps, the Visual Resource Management Classes (MAP 23) were determined. The Skedaddle Mountains and the area nearest to Highway 395 in both the Wendel-Amedee and the Island segments fall into Class II. The remainder of the Island and the Viewland area are Class IV, with the remaining portion of the Wendel-Amedee segment falling into Class III.

2. Recreation

Recreation in the area includes a variety of uses ranging from competitive motorcycle racing to hiking and other solitude-seeking activities. Other uses are off-road vehicle (ORV) pleasure riding, rock collecting, hunting, sightseeing, and enjoyment of the remote, primitive appearance of parts of the area (TABLE 41).

Much of the data on recreation activities were gathered for the Unit Resource Analyses (URA) for the Cal-Neva and Honey Lake Planning Units. As there are no developed recreation sites within the study area, all use occurs at undeveloped areas. With the exception of activities authorized through permits (motorcycle races), no accurate data are available concerning visitor use.

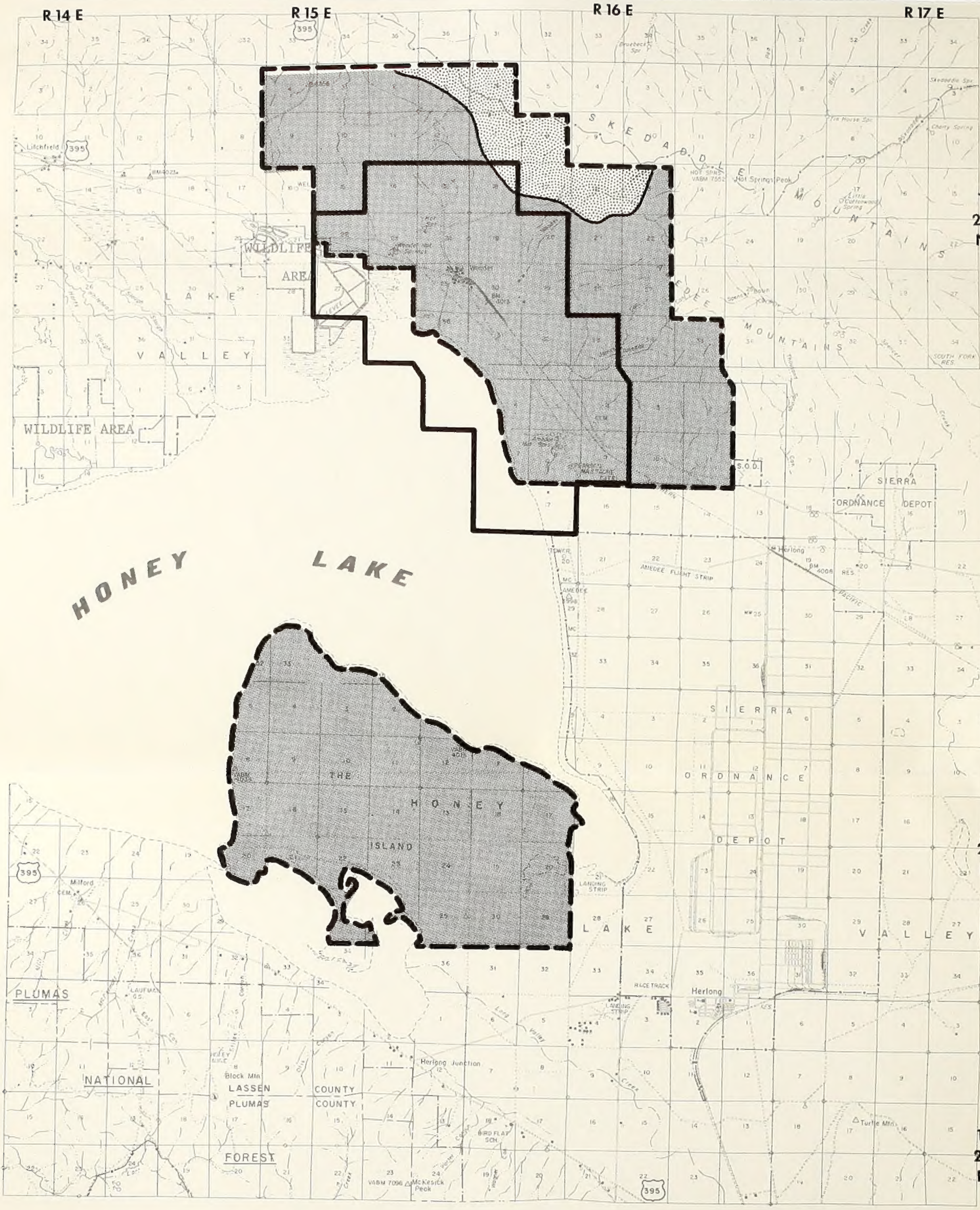
Motorcycle Events

Motorcycle events are held annually in the District. These events, usually Enduros, consist of two main areas of activity: the start and camping area, and a course consisting of one or more

TABLE 40
RELATIONSHIP OF NEARBY DEVELOPED RECREATION AREAS TO THE STUDY AREA

RECREATION AREA	ADMINISTRATION	LOCATION	DISTANCE FROM STUDY AREA BOUNDARY	VISUAL PROMINENCE OF STUDY AREA FROM RECREATION AREA 1/
Dakin Unit-Honey Lake Wildlife Area	California Department of Fish and Game	3 miles SE of Standish	5 miles W of Wendel-Amedee Area	Wendel-Amedee - B Island - B
Fleming Unit-Honey Lake Wildlife Area	California Department of Fish and Game	3 miles W of Wendel	Partially within Wendel-Amedee Area	Wendel-Amedee - S Island - S
Herlong Recreation Areas	Sierra Army Depot	In Herlong	2 miles SE of Island Area	Wendel-Amedee - S Island - S
Honey Lake Camp-ground	Private	Hwy. 395, 2 miles NW of Milford	5 miles W of Island Area	Wendel-Amedee - B Island - F
Honey Lake Roadside Rest	California Department of Transportation	Hwy. 395, 5 miles SE of Janesville	8 miles NW of Island Area	Wendel-Amedee - B Island - B
Janesville County Park	Lassen County	Hwy. 395, at Janesville	13 miles NW of Island Area	Wendel-Amedee - B Island - B
Laufman Campground	Plumas National Forest	3 miles S of Milford	3 miles SW of Island Area	Wendel-Amedee - S Island - S
Milford	Private	In Milford	3 miles SW of Island Area	Wendel-Amedee - B Island - F

1/ F = Foreground-Middleground; B = Background; S = Seldom Seen.



LEGEND

Study Area Boundary

Class-B

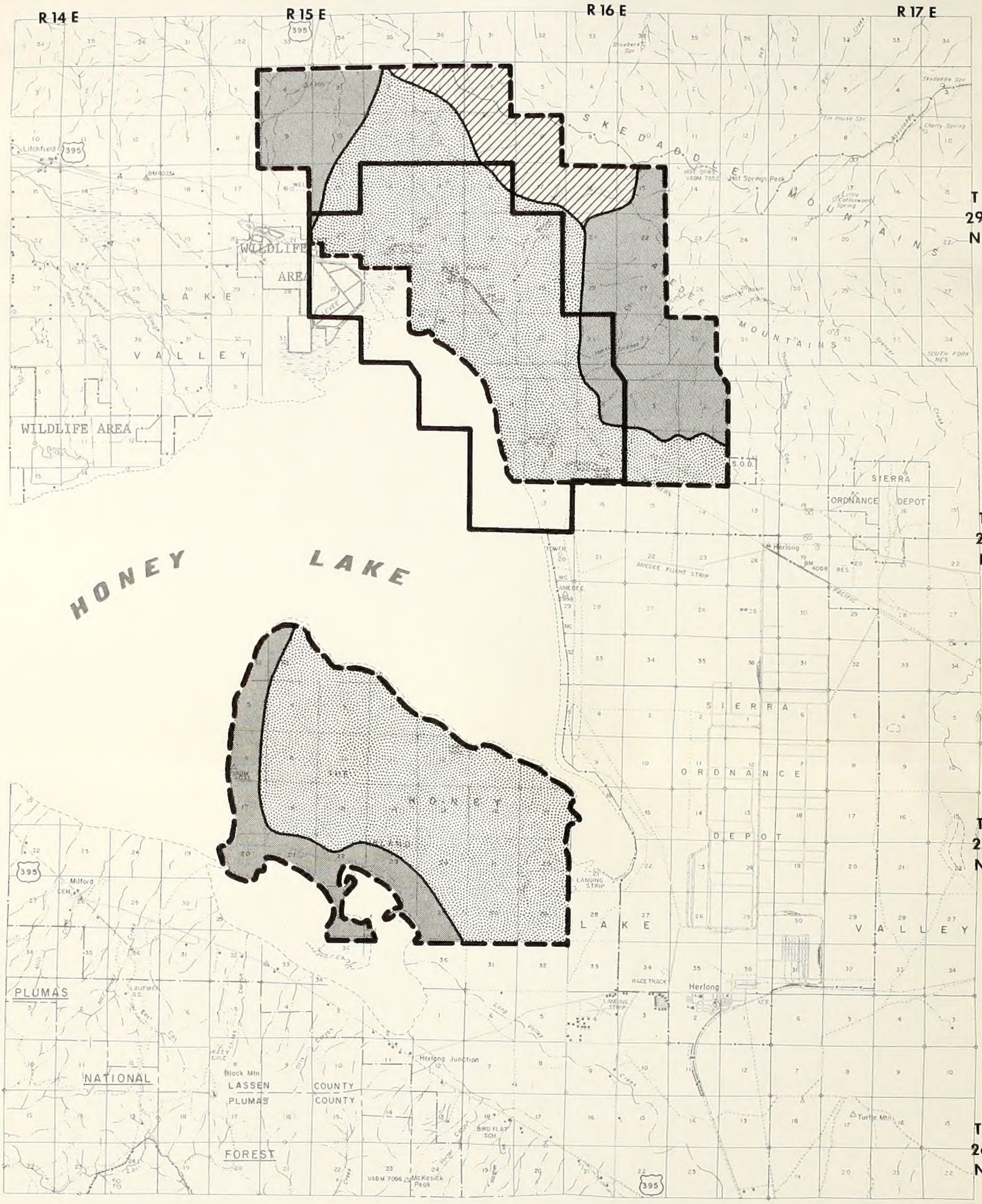
Class-C

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

SCENIC QUALITY CLASSES

SCALE: ½" = 1 MILE   MT. DIABLO MERIDIAN

MAP-20



LEGEND

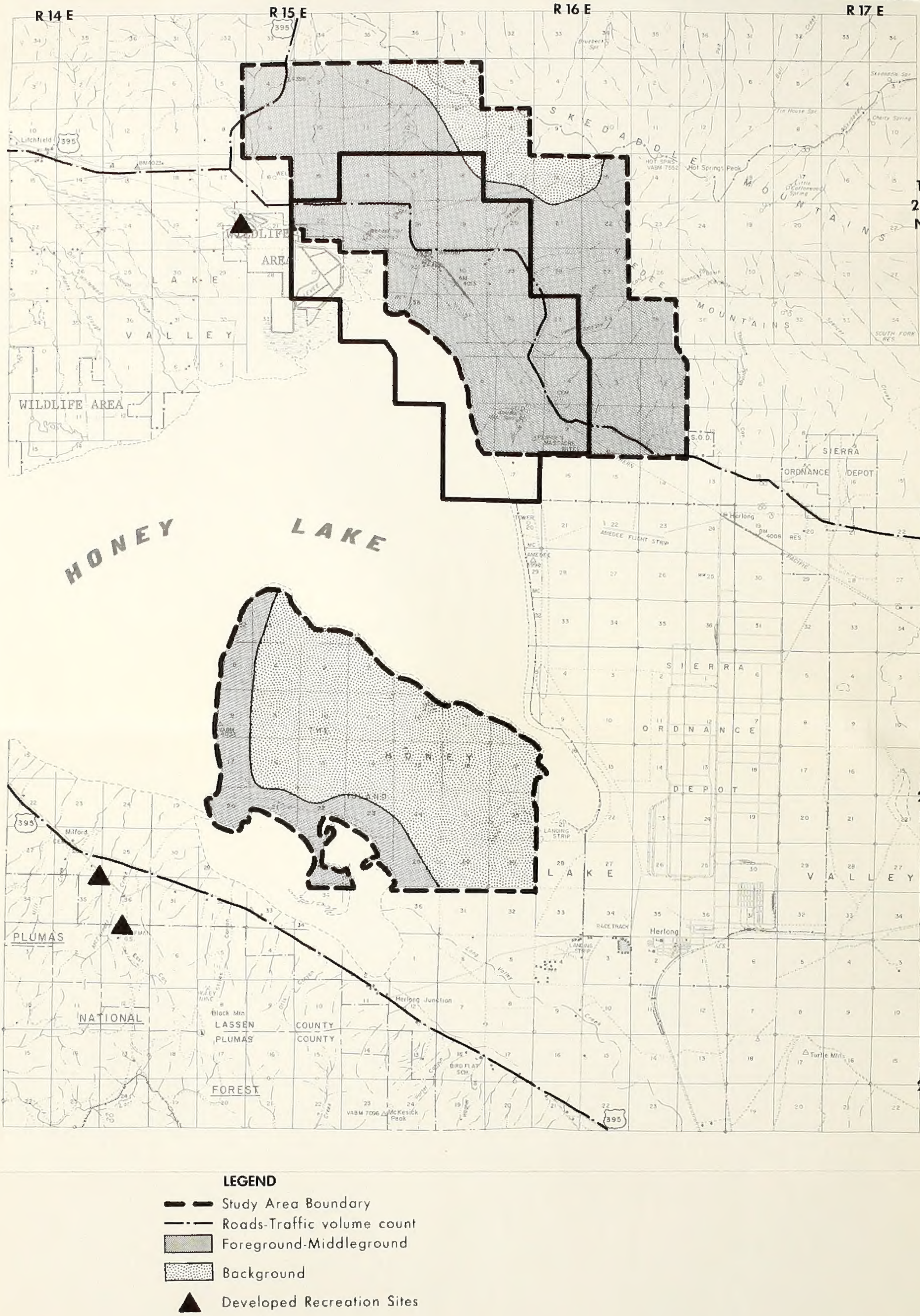
- Study Area Boundary
- High Level
- Medium Level
- Low Level

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

VISUAL SENSITIVITY LEVELS

MAP-21

SCALE: ½" = 1 MILE MT. DIABLO MERIDIAN

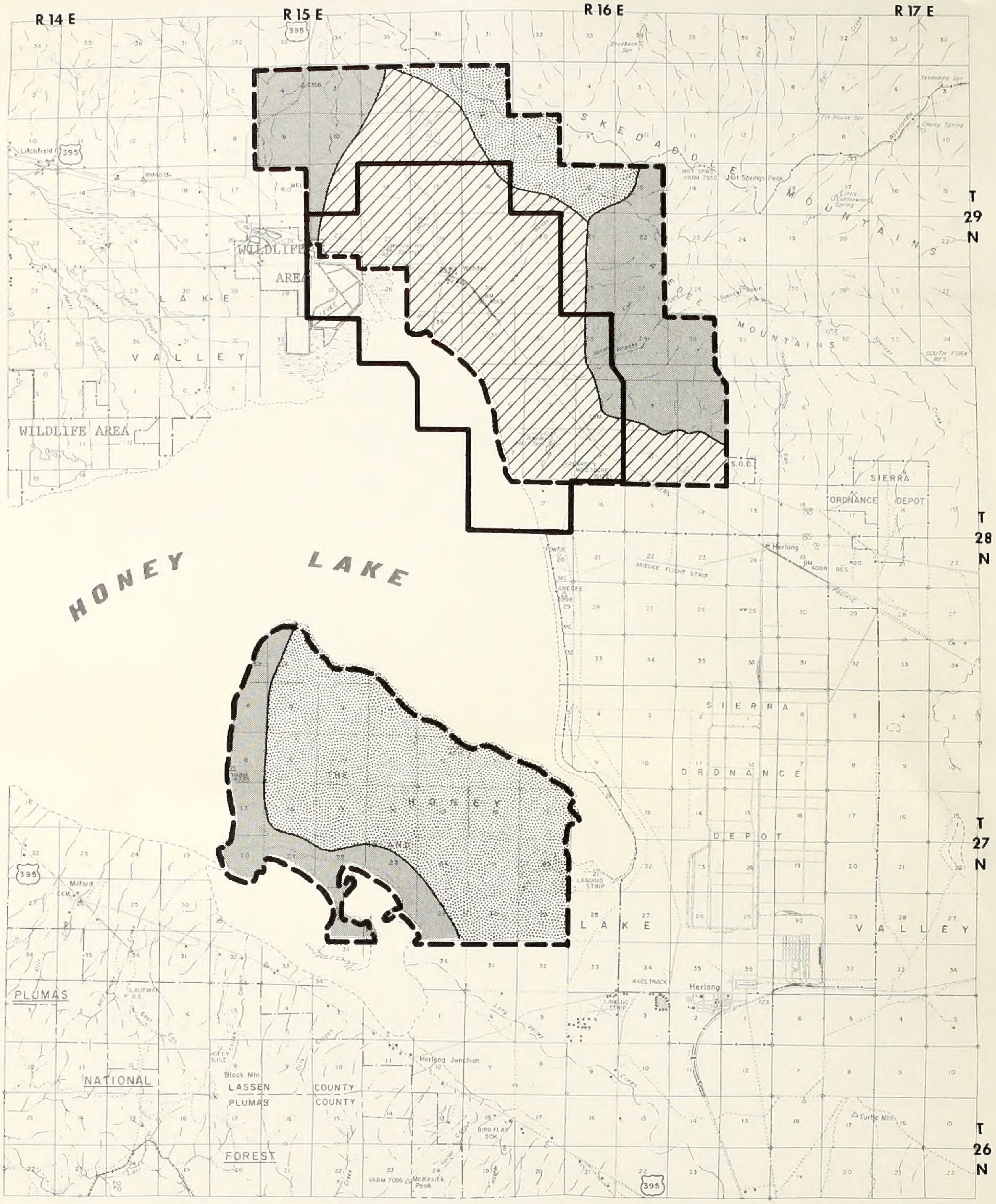


HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

VISUAL PROMINENCE ZONES

MAP-22

SCALE: ½" = 1 MILE MT. DIABLO MERIDIAN



LEGEND

Study Area Boundary

Class II

Class III

Class IV

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

VISUAL RESOURCE MANAGEMENT CLASS

MAP-23

SCALE: ½" = 1 MILE   MT. DIABLO MERIDIAN

TABLE 41
TRAFFIC VOLUME

Highway or Road Number	Segment	Average Daily Traffic
Highway 395	Janesville-Doyle	3,000
Highway 395	Johnstonville-Litchfield	1,500
County A-3	Highway 395-Standish	1,100
Highway 395	Litchfield-Ravendale	750
County 359	Highway 395-Herlong	600
County 313	Highway 395-Herlong	500
County 305	County A-3-Highway 395	300
County 320	Highway 395-Stateline	100

Source: Regional Transportation Plan and Final Environmental Impact Report, Lassen County, April, 1975.

loops, totalling approximately 100 miles in length. Enduro motorcycle events involve a series of four riders, starting at set intervals. The object is to reach check points in a predetermined time interval with score points deducted for early or late arrival.

Events have been held in the study area since 1970, with the number of riders per event ranging from 160 to 370 (TABLE 42). Only small portions of these event routes extend into the study area. Several of the races have had their camping and start areas at the gravel pits near Wendel (MAP 24).

ORV Pleasure Riding

Recreation vehicle use within the study area is almost totally motorcycle riding with the exception of the ORV use directly associated with other recreation activities, such as hunting.

Local residents frequently utilize the area for family or weekend riding. Interviews with several local riders (Lawrence, 1976, and Moody, 1976), along with personal observations by District personnel, have led to the categorization of recreation vehicle use into medium use, low use and no-use areas (MAP 24).

In the Honey Lake and Cal-Neva Management Framework Plans (MFP), portions of the study area were recommended for designation into each of the ORV categories: Open, Closed and Regulated (MAP 24).

Primitive/Wilderness Values

Through the Bureau Planning System, the Skedaddle-Amedee Range had been rated as having the highest primitive value in the Eagle Lake Resource Area. Approximately 40,000 acres were recommended in the Cal-Neva MFP for designation as a primitive area.

The Lassen County General Plan identifies the Skedaddle-Amedee area as a prime recreation area, an area where significant resources should be "protected from spoilation or inappropriate development." This prime recreation area is included within BLM's visual resource management (VRM) Class II.

As a result of the Federal Land Policy and Management Acto of 1976, all roadless parcels of BLM land that contain 5,000 or more acres must be considered for wilderness values and possible inclusion in the Wilderness System.

Based on the roadless definition and the guidelines for excluding private lands on the perimeter of such roadless areas, an area somewhat larger than that originally recommended in the MFP has been identified (MAP 25). This roadless area includes the MFP recommended primitive area.

TABLE 42
RELATIONSHIP OF DISTRICT ORV RACES TO STUDY AREA

Year	Type of Race	Within Study Area (Wendel-Amedee Section)			Participation	
		Start	Finish	Miles of Route	Entrants 1/	Spectators (Estimate)
1970	Enduro	Yes	Yes	12	2/	50
1971	Enduro	Yes	Yes	11	2/	200
1972	Enduro	Yes	Yes	11	2/	200
1973	Enduro	No	No	None	306	300
1974	Enduro	Yes	Yes	16	247	200
1975	Enduro	Yes	No	2	270	200
1975	Hare 'n Hound	No	No	None	50	225
1976	Enduro	Yes	No	0.5	370	500

1/ Beginning in 1973, payment of fees was based on number of riders, thus actual counts were obtained.

2/ Exact numbers unknown.

Source: District Special Land-Use Permit (SLUP) and Recreation-Use Permit (RUP) Files.

Important resource values within the roadless area include the rugged, undisturbed terrain of the mountains rising some 3,500 feet from the valley floor to a peak of 7,574 feet; evidence of Indian habitation sites in Wendel Canyon and Tommy Tucker and Amedee Caves in the Amedees; numerous species of wildlife, including prairie and peregrine falcon sightings on Amedee cliff, mountain lion at higher elevations and a potential bighorn sheep plant site; several prominent canyons with unusual rock formations such as those in lower Wendel Canyon; numerous springs, several near the upper peaks; thick growths of willow in many canyons, aspen groves on the northeast slopes of the Skedaddles; and excellent scenic views of Mount Shasta and Mount Lassen, of Honey Lake Valley and the Smoke Creek Desert and the forested (often snow-capped) Sierra peaks.

With wilderness designation, a wide variety of recreation opportunities would continue to be available in the Skedaddles-Amedees, including hiking, horseback riding, hunting, mountain climbing, scenic photography, nature study, wildlife observation and photography, archaeological study, camping, environmental education, etc.

Other Recreation Activities

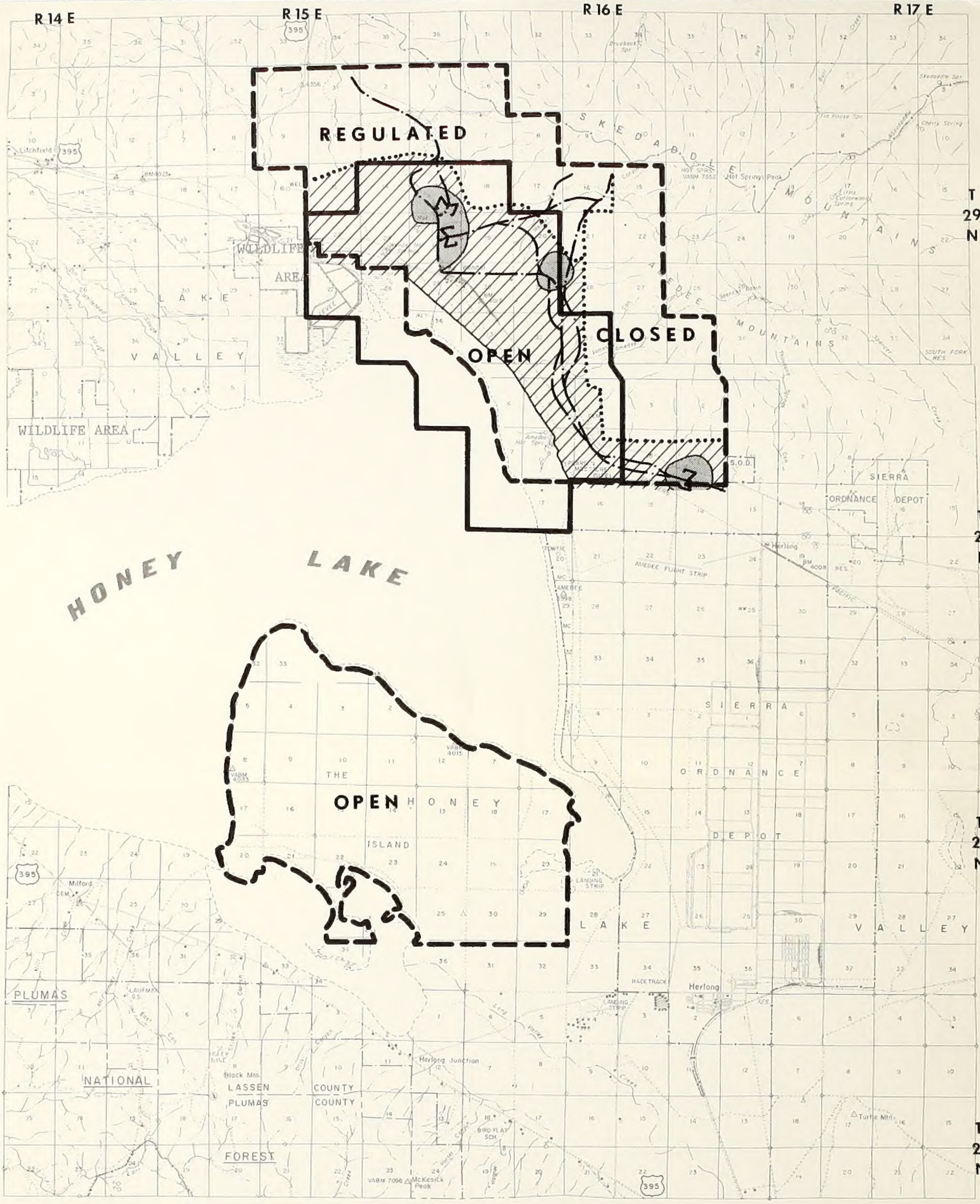
The major recreation activities within the study area have been covered in the previous paragraphs. General sightseeing or driving for pleasure is included in the Aesthetics section of this report. In addition, a number of other recreation uses do occur within the area on a very limited or localized basis (MAP 25).

Hunting within the area is primarily for upland game: chukar, dove, and quail, with chukar hunting by far the most important of the three. A small amount of antelope and deer hunting occurs in the higher elevation basins. The majority of this hunting activity is day-use by local residents with very little overnight camping. Hunting seasons for the various species are set annually by the California Department of Fish and Game.

Local residents collect small specimens of tufa from the formations near Wendel for decorative or landscaping purposes. Contact with the Lassen Gem and Mineral Society (Hudson, 1976) revealed no extensive use of the study area by rockhounders. An old District recreation use map indicates bottle hunting on the Island, while artifacts from pioneer and early ranching times can be found throughout the area.

The only known camping in the area is the limited amount associated directly with another activity, such as hunting or motorcycle racing.

Arcaheological sightseeing includes visits to Tommy Tucker Cave, high on the Amedee cliffs. Geologic sightseeing occurs at the tufa formations north of Wendel, while botanic sightseeing occurs whenever a wet winter provides sufficient wildflower displays.



LEGEND

- Study Area Boundary
- Recommended O R V Designation Boundaries
- Composite of Race Routes 1970-1976

O R V Pleasure Riding:

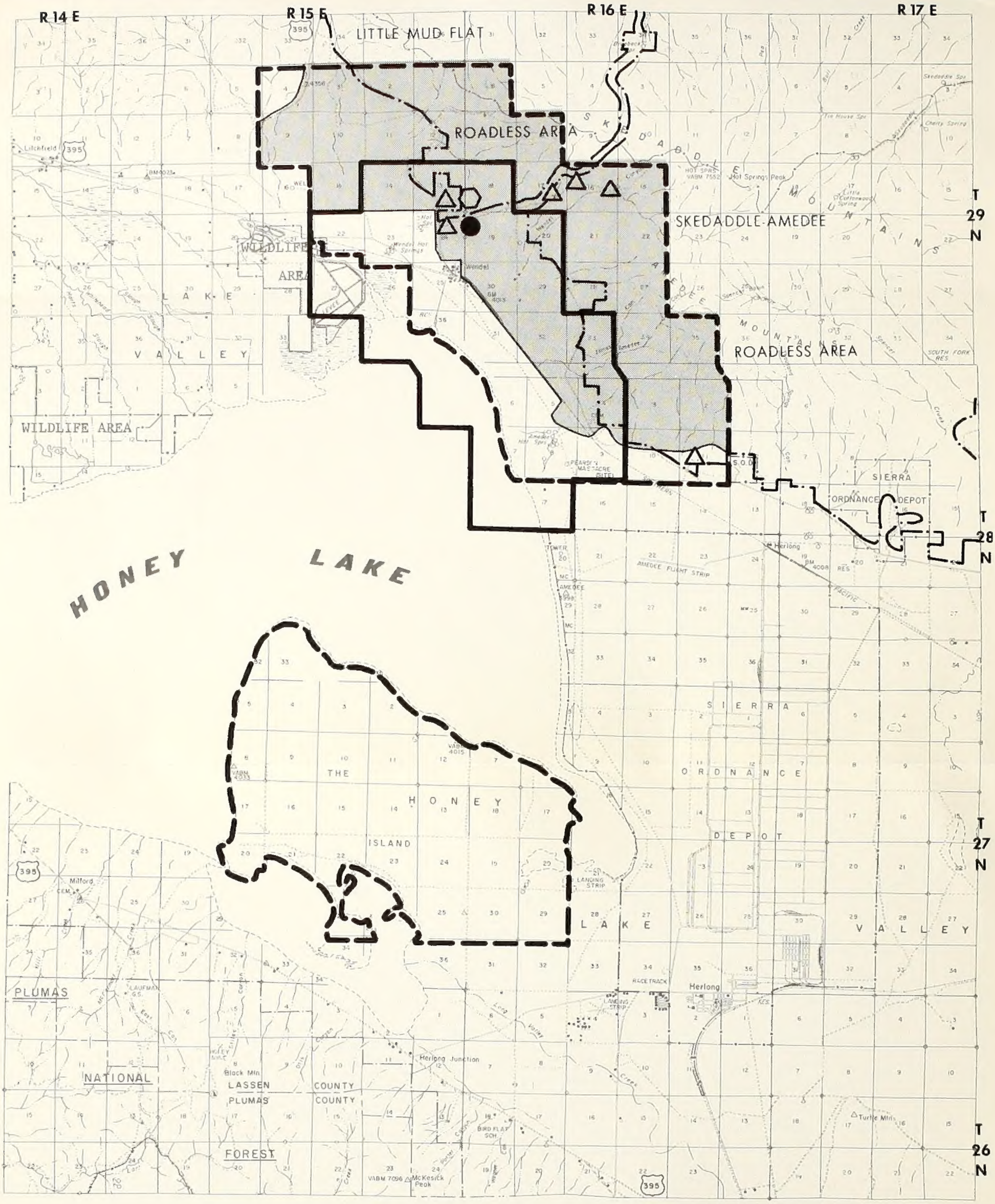
- Medium Use
- Low Use
- No Use
- Σ Start and Finish Areas for O R V Races

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

RECREATION USE—O R V

MAP-24

SCALE: ½" = 1 MILE   MT. DIABLO MERIDIAN



LEGEND

- Study Area Boundary
- Roadless Areas
- Hunter Use Area
- Rock Collecting
- Geologic Sightseeing
- Undeveloped Camp Areas

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

OTHER RECREATION USES

MAP-25

SCALE: ½" = 1 MILE MT. DIABLO MERIDIAN

3. Archaeological and Historical Resources

Wendel-Amedee Area

a. Archaeological Resources

From the time of the earliest historical documentation and probably for several centuries in advance of that era, the Wendel-Amedee area has fallen in the heartland of the territory of the Honey Lake Paiute. While in portions of the Honey Lake Valley the Paiute shared territorial boundaries with the Maidu, Washoe, and Pit River Indians, and while Native American boundaries often were flexible, historic and ethnographic testimony indicates that the cliffs, flats, alluvial fans, and lake-margin environments of the Wendel-Amedee area were occupied and exploited, at least in recent times, almost exclusively by the Wadatkut group of Northern Paiute. It is inferred ethnohistorically, and modern Paiute sentiment endorses the view, that all Late Prehistoric archaeological resources within the area pertain to that group.

Paiute occupation of Honey Lake Valley was sparse in historic times. Riddell (1960) reconstructs approximately 200 persons as the total population of the group in the immediately prehistoric period, and, though that figure was subject to reduction with the advent of white settlement, it probably constitutes as accurate an estimate of the aboriginal population density as ever will be available. The populace was distributed in two separate but frequently interacting groups, one based largely in Secret Valley and the eastern portion of the Madeline Plains, the other occupying the bulk of Honey Lake Valley.

Both ethnographic testimony and archaeological reconstruction indicate that Paiute subsistence strategy, rather than concentrating on a single envirnomental resource, or on a group of closely related and geographically clustered resources, was wide ranging and diverse in its interests. Varieties of seeds, roots, berries, and bulbs were taken from the valley floors, slopes, and upland meadows, small and large game animals were hunted in the same settings and in the mountains, waterfowl were taken from the sloughs and marshes of Honey Lake, and fish were caught in the lake and its tributaries. Black oaks at the base of the Diamond Mountains provided an annually important acorn harvest.

Because, however, the resources on which the Paiute depended were widely scattered and the abundance of most of them tended to be seasonal, few places could support year-round the subsistence needs of a settled community. In consequence the Paiute, like most other Great Basin groups (save those who, by virtue of a specialized lake-margin economy, could intensively exploit a more limited range) were prone to many movements throughout the year. The bands which in winter congregated in villages to live on stored foods, in spring and summer divided to exploit localized resources, occupying several temporary camps, gathering sites, and hunting and milling stations. Procurement of certain other, non-seasonal, resources (such as the obsidians and fine-grained basalts which were the raw material for flaked stone implements) was probably scheduled to take advantage of visits to nearby stations in the seasonal round.

Settlement shifted on a yearly basis as well; individual temporary camps were only occasionally occupied, and even winter villages might lie unvisited some years. In consequence, the physical traces (and thus the archaeological record) of even a moderately sized group bulks very large and is widely dispersed. Given several thousand years of human tenancy of the area, during most of which there appears to have been little change in land-use patterns, it can be predicted that any such extensively occupied tract of land (and particularly one which, like the Wendel-Amedee area, boasts multiple microenvironments and a fair volume of reliable, year-round water) will display a structurally complex, very abundant array of archaeological sites.

Recent Paiute occupancy is documented in living memory by the occurrence of two historically frequented winter village sites (both named Pamu) at the Wendel and Amedee Hot Springs, two ethnographically recorded cave sites (both named Numuta) on the cliffs and slopes east of Wendel and Amedee, an occasionally occupied village site on the flat known as Huhnuhduhuhp southeast of Wendel, and the large village complex of Tupi' twaba around the hot springs northeast of Wendel (Riddel, 1960).

Each of the ethnographically identified occupation sites discloses evidence of prolonged, repeated habitation. It cannot be assumed, however, that all archaeological resources within the area, nor even the earlier components of known recent Paiute sites, were occupied always and only by the Paiute. Indeed, much linguistic evidence suggests that the Paiute were relative latecomers in the northern Great Basin, expanding into the region perhaps as recently as 1,000 years ago (Lamb, 1958). The ethnic identity of earlier occupants is at present irretrievable by ethnohistory and archaeologically may always remain obscure, but their inarguable presence is demonstrated by the incidence of numerous ancient artifact types.

Because prior archaeological survey in the Wendel-Amedee area (conducted almost exclusively by F.A. Riddell in the 1950's and 1960's) has been sporadic and largely intuitive, and excavation limited to the two Numuta cave sites (Fenenga and Riddell, 1949; Riddell, 1957), scientific reconstruction of the details and changes of prehistoric life will rest on evidence still lying on and in the ground. Recognized surface materials indicate a wide variety of prehistoric activities and adaptive strategies; an understanding of the systematics of these activities must await controlled excavation and the analysis of undisturbed deposits. Comparative data from surrounding regions such as Secret Valley (Riddell, 1960) and Surprise Valley (O'Connell, 1971) offer the bases for cultural-ecological models of aboriginal dry-land adaptation which may well have been operative prehistorically in the Honey Lake Valley; testing such models for congruence will constitute an important element of future archaeological research designs within the study area.

Likewise, while presently recorded datable artifacts (e.g., Elko Eared Projectile Points) signal an antiquity of human occupancy extending back perhaps to 2000 B.C. (Hester and Heizer, 1973), the era of earliest habitation cannot be defined until extensive excavations have addressed

the question. Private collections accumulated under uncontrolled conditions, for example, contain Northern Side-Notched projectile points, regionally datable as early as 4000 B.C. Further, materials from surrounding regions and, in some instances, from Honey Lake Valley itself (Tadlock 1966; Busby 1976) have suggested a possible affiliation with the 'Western Pluvial Lakes Tradition' of 9000-6000 B.C. (Bedwell, 1970; Hester, 1973 p. 62-68). The possibility of a yet more ancient human presence cannot be discounted; the waters of Pleistocene Lake Lahontan lapped the slopes of the Amedee and Skedaddle Mountains at the northeastern flanks of the study area, and along the old shorelines buried deposits may yet await discovery. The chronology of the area in relation to surrounding zones is presented in TABLE 43.

Although virtually untapped by controlled archaeological investigation, few sites in the study area appear to have escaped the attentions of modern collectors and vandals. Not only have enormous private collections been amassed through surface, search, but illicit excavation is evident as well. In consequence, no sites within the area can be considered pristine; the surfaces of open sites have been scoured for artifacts, with the result that in general only chippage and broken milling stones are left exposed, and the integrity of both open sites and caves has been significantly altered.

In addition to pressures from vandalism, archaeological sites within the study area have in several instances been inadvertatnly impacted by modern developments. Particularly severe impacts have accured from construction of the Southern Pacific Railroad line, the Eagle Lake irrigation roads, a recent dump site, and the development of modern habitation at Wendel and Amedee. In several instances, the integrity of archaeological sites (and therefore their potential eligibility for inclusion on the National Register of Historic Places) has been significantly reduced.

Because prior reconnaissance of the study area was judged insufficient to identify the quantity and quality of archaeological resources which might be adversely impacted by geothermal development, a two-element research program was initiated which included (MAP 26):

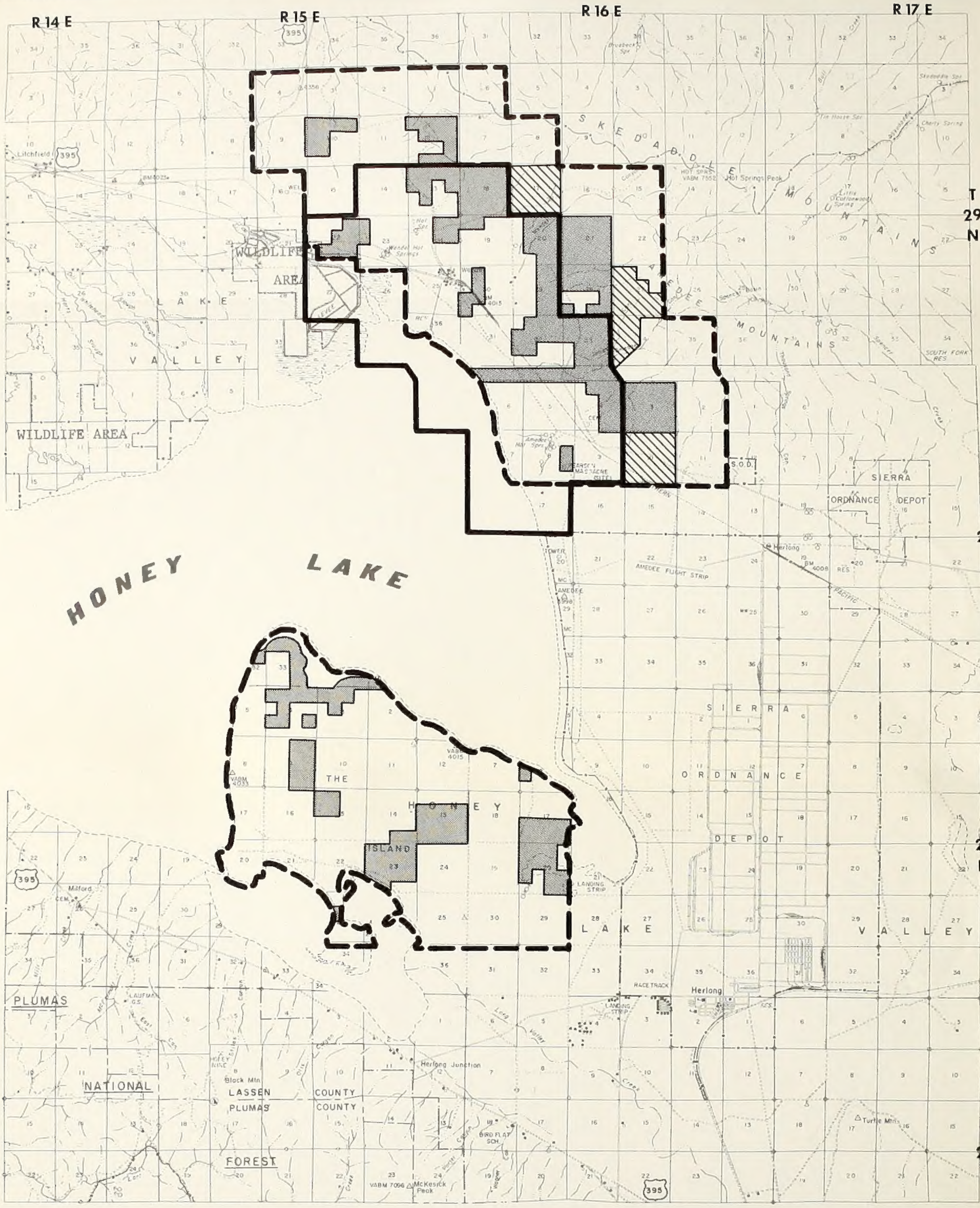
(1) An intensive, on-the-ground archaeological survey of the seven potential leasing units in the Wendel-Amedee area, comprising full recordation of all newly located archaeological sites as well as redocumentation (with newly gathered information) of all sites recorded in previous surveys.

(2) Intensive survey of 2,040 acres of the mile-wide buffer zone surrounding the proposed leasing area, selected to test the incidence of archaeological sites in the four distinct physiographic settings which characterize the area (valley flats, lowland slopes and alluvial fans, cliffs and steep canyons, and mountain ridges and peaks).

TABLE 43

PREHISTORIC CHRONOLOGY OF HONEY LAKE VALLEY AND THE WESTERN GREAT BASIN
(after Hester, 1973)

TIME	ARCHAEOLOGICAL PHASES			
AD/BC	Karlo (Secret Valley) (Riddell, 1960)	Tommy Tucker Cave (Riddell, 1960)	Surprise Valley (O'Connell, 1971)	Pyramid & Winnemucca Lakes
1950	Amedee	Amedee	Bidwell	Late Prehistoric
1000			Alkali	Rose Spring/Eastgate
0	Late (Lovelock)	Late (Lovelock)		
1000	Karlo	Karlo	Emerson	Late Lovelock
2000			Bare Creek	Culture
3000				Early
4000			Menlo	"Lakeshore
5000				Ecology"
6000				
7000			?	Western
8000				Pluvial Lakes
9000				Tradition
				?
				Fishbone Cave



LEGEND

Study Area Boundary

Intensive Survey of K G R A and Non-competitive Lease Applications

Intensive Survey Outside of K G R A and Leasing Units

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

ARCHAEOLOGICAL COVERAGE

MAP-26

SCALE: ½" = 1 MILE MT. DIABLO MERIDIAN

Field methodology consisted of a pedestrian survey conducted by survey parties of 1-3 persons. All survey tracts were transected at 200-250 foot intervals, requiring some 22 passes per mile surveyed. While geometrically parallel corridors were maintained, the pass through each meandered to maximize coverage. Particularly, deflections were warranted to allow the examination of erosion cuts, disturbed soil, drainage banks, benches, and rock outcrops.

The survey resulted in the identification and recordation of 60 archaeological sites within the study area, 56 of them lying on national resource lands, and 47 within the potential leasing units. Twelve sites had been previously recorded. So great an intensity of prehistoric activity indicates that the northeastern margin of Honey Lake has, for several millenia, provided an environmental setting richly endowed with the prerequisites for continued human exploitation. Because, however, certain places fulfilled better than others the demands of certain human needs, there is great variability in the nature of definable prehistoric activity centers.

On the basis of site size, location, and surface artifact constituency, archaeological sites located during the survey can be segregated into eight categories reflecting recognizable prehistoric functions. Such a classificatory scheme emphatically is not chronologically based nor are the defined categories mutually exclusive; subsurface components may conceal other, variable past usages, and even on the surface, multiple functions may be indicated. The proposed classification addresses only the question of site-type variability as it can be determined through surface reconnaissance; more detailed analyses, particularly those which might reflect significant past changes in prehistoric adaptive strategies and changing patterns of settlement and site location, are achievable only through controlled excavation.

Defined site categories are as follows:

1. Villages: Large occupation sites with midden deposits and pronounced vertical as well as horizontal dimensions (indicating prolonged or repetitive human usage) and a complex, multifunctional assortment of artifact types, including, but not limited to, chipped stone hunting, butchering, and fleshing implements, cutting tools, and ground stone food preparation implements.

2. Temporary or seasonal camps: Open occupation sites with multifunctional artifact assemblages, exhibiting more limited areal dimensions, lower intensity surface concentrations of cultural materials, and the accumulation of little or no vertical deposits.

3. Lithic scatters/chippage assemblages: Sites exhibiting only the detritus of stone flaking technology, with a relatively low artifact/chippage index, and with neither ground stone food preparation equipment nor midden deposits.

4. Quarries: Lithic task sites exhibiting local availability of the preferred raw material (in the Wendel-Amedee area, basalt), flaking cores of the same material, decortication flakes, and occasionally, definable core break-up areas.

5. Isolated milling stations: Single or clustered seed milling stones (manos and metates) associated with minimal (if any) stone chippage and exhibiting no depth of deposit.

6. Caves/rock shelters: Natural geologic features with evidences of human occupation or usage. Such sites may exhibit variable or multiple functions (e.g., they may co-occur with petroglyph sites).

7. Piled stone constructions: Alignments or walls of piled native stone (consisting, within the study zone, only of ridge crest hunting blinds).

8. Petroglyphs: Aboriginal designs on boulders or native rock faces, executed by abrasion, pecking, or painting.

Archaeological survey forms for all sites recorded or rerecorded during the 1976 survey, together with a plotting of their locations on USGS 15 minute topographic maps, will be filed in the Department of Anthropology, California State University, Chico, the Archaeological Research Facility, University of California, Berkeley, and the California Department of Parks and Recreation, Sacramento. In addition, qualified researchers may obtain site data from the Susanville District Office of the Bureau of Land Management.

b. Archaeological Resources of National Register Quality

No sites within the study area are currently listed on the National Register of Historic Places; however, two large districts and one archaeological site appear to qualify on the basis of the criteria set out in 36 CFR 800 for inclusion on the National Register. Each of these loci will be submitted for formal determination of their National Register eligibility.

(1) Tupi' twaba District: Covering some 240 acres of national resource lands and extending well onto adjacent private lands (ca. 240 acres), this district presents the densest concentration of significant archaeological materials within the study area. Five major village localities (including the enormous site occupied in the historic period under the name Tupi' twaba) and an associated lithic scatter lie along a system of stabilized dunes and low foothill slopes. The quantity of cultural materials and the functional variety of artifacts observed on the surface far exceed those of any other site or district surveyed in the present effort. Great quantities of chippage litter the surface, composed principally of basalt but containing a small fraction of obsidian as well. Chipped stone artifacts include projectile points, knives, a variety of scrapers, cores, core-tools, and utilized flakes.

Milling stones, of which more than 150 fragments have been tallied on the surface, consist for the most part of manos and metates formed of local basalt; in a few instances, however, granite milling stones were imported, probably from the Diamond Mountains on the south side of Honey Lake Valley. All of the five major occupation sites show evidence of vertical deposit, and burials (especially cremations with shell bead offerings) have at times eroded from the surface of the principal village.

The district's potential for supplying information significant to prehistory is enormous, particularly with respect to clarifying questions on the nature of culture change and the evolution of cultural-ecological relationships. Controlled excavation of vertical deposits should repay inquiry into cultural, faunal, and palynological sequences, as well as supplying useful details on the distribution of intrasite and intersite activity foci.

The physical integrity of all sites within the district is relatively good; a paved road, a dirt road, and an irrigation ditch cross individual sites, but their cumulative impact has been slight. More significant, the largest village has been well known to local collectors for several decades, and the surface has been combed regularly for artifacts. There is, however, little evidence of illicit excavation.

2. Viewland Pass District: The 240 acres of this potential National Register district encompass six archaeological sites, five of them villages or large base camps. While the density of cultural materials is less than that of the Tupi' twaba District, the region shows evidence of long-term, repeated occupation by fairly large prehistoric groups. One of the principal surfaces displays over 100 milling stones and fragments, testifying to intensive plant collecting and food preparation activity. Stone flaking debris, while present on all occupation surfaces, is relatively sparse, and is confined almost exclusively to basalt (natural fine-grained basalts outcrop upslope from the occupation zone). Each of the five village sites gives evidence of vertical deposition, though the depth of all of them awaits controlled testing. The district offers the potential for the recovery of significant data on intersite variability in a zone where several apparently similar sites, closely spaced, occupy virtually identical environmental settings.

The integrity of all sites within the district is generally superior, despite minor disturbances wrought by dirt roads and an irrigation ditch. Surface collection has apparently been not intense, and no illicit excavation has been discovered.

3. Tommy Tucker Cave: This small cave, located on the cliffs east of Amedee, was professionally excavated with the removal of virtually all of the cultural deposit present (Riddell and Fenenga, 1949; Riddell, 1956, 1957). The study formed an important basis for fixing chronologically a significant portion of the human occupancy of Honey Lake Valley; datable projectile points signal an affiliation with the Late Lovelock culture, with an inception perhaps at 2000 B.C.

Although the cave's era of principal occupancy had apparently lapsed by the Late Prehistoric period, some materials (including a Desert Side-Notched projectile point, still hafted) indicate that even in recent times it was at least sporadically visited. The dry deposit allowed the preservation of otherwise perishable materials, including a large number of twigs apparently related to a variety of Paiute gaming activity which survived into the historic period.

While total excavation has effectively eliminated the possibility of the cave making any further contribution of data significant to prehistory, it retains a set of local associations of not inconsiderable importance. Besides being the first site professionally excavated in Lassen County (and, incidentally, the first recorded by the California Archaeological Survey, in whose files it is designated 'Lassen-1'), Tommy Tucker Cave is well known in Honey Lake Valley and valued as a vital landmark of the region's prehistoric past. Native Americans, avocational archaeologists, and local historians, as well as those with only casual passing interests, have frequently mentioned the cave in the course of consultations. So often do local passersby visit the site to view the interior and the relatively well-preserved petroglyph panel at the entrance that a well-worn trail, visible for miles, now ascends the arduous slope. Moreover, the site has been listed in the California Department of Parks and Recreation's California Inventory of Historic Resources (1976). It is the only site in the study area so listed.

c. Historical Resources

The historic era of Honey Lake was inaugurated by the pioneering travels of Peter Lassen. In 1850, in futile search for a reported 'Gold Lake' of enormous riches, Lassen, J.G. Bruff, and their companions saw Honey Lake from the pass at Viewland, thereby lying the fairest claim for the discovery of the Lake and Valley (James P. Beckwourth's calim of an 1845 discovery has been generally rejected by historians; cf. Fairfield, 1916: 16-17).

The visit of the first explorers was brief, but in the following year (1851), pursuing the same quest, William H. Nobles worked his way east across Honey Lake Valley and through the pass between Shaffer Mountain and the Skedaddle Mountains, approximating the route of the modern U.S. Highway 395 as it creasts at Viewland. From there Nobles pursued a route across the southern end of Secret Valley, along the drainage of Smoke Creek Canyon and thence to the side of the Smoke Creek Desert. By the time he intersected the Southern Oregon trail on the Black Rock Desert of Nevada he realized that he had discovered a passage to California which avoided many of the ardours of the Lassen Trail. Nobles quickly advertised the virtues of the new route, which was faster, more direct, and less hazardous than Lassen's more circuitous approach. By the years 1853-1854 the new trail had been enthusiastically adopted and became one of the principal avenues to California from the east (Amesbury, 1964, p. 6-8; 1967).

The same years saw the inception of settlement in the valley. Isaac Roop, capitalizing on the increased travel through the area, staked a land claim at the west end of Honey Lake in 1853, and in 1854, established his trading post. By 1856, a number of settlers had located in the valley, designating the new territory Nataqua.

With the intensification of white settlement in the area, Native American culture came under increasingly disruptive pressures from land encroachment, competition for resources, and often unrestrained cruelties on the part of the settlers. Relations had become particularly strained by 1860 when the famous Paiute convocation was held at Pyramid Lake, Nevada. The ensuing 'Pyramid Lake War' (or 'Ormsby Massacre') initiated nearly a decade of frequently violent encounters which invaded not only Honey Lake Valley but the Wendel-Amedee area as well.

The most notorious of the hostile confrontations within the study area (and still commemorated by a sign marking the site) was the 'Pearson Massacre' of 1868. While settlement of the Wendel-Amedee area was sparse at the time, Thomas Pearson, his family, and his partner moved from Long Valley to a new homestead south of the Amedee Hot Springs in 1867. The following year, the Pearsons and a hired man were killed for reasons which have never become obvious.

In consequence, vigilante parties ranged the countryside, three Indians charged with participation in the massacre were hanged, and a secret lodge was established in Susanville, calling itself 'The Exterminators' and taking as its charge the annihilation of the local Indian population. While the fervor for revenge quickly subsided, no further settlers suffered the fate of the Pearsons (Fairfield, 1916, p. 445-465).

The florescence of the Wendel-Amedee area did not occur until 1890. In that year, the NC&O narrow gauge railroad was extended from Liegan to Amedee, where a temporary terminus was established. Lacking many resources of its own the new railhead nontheless derived considerable importance from its status as the premier shipping entrepot of Honey Lake Valley. A town sprang up at Amedee and quickly flourished. At its zenith, the site hosted a population 300-400. Two hotels, a restaurant, a barber, butcher, and blacksmith served the many newly established residences. For a few years, Amedee enjoyed an exuberant prosperity; cattle and sheep were transported from the railhead, lumber was ferried across Honey Lake, and local fruit contributed importantly to the valley's rail-supported export (Myrick, 1963; Middleton, 1963, p. 38-39).

The fortunes of Amedee, however, were destined to be short-lived. In 1899, the NC&O began construction of an extension to the north; the town of Wendel began to experience its own expansion the following year, and by 1900 the operation had been extended as far north as Termo on the Madeline Plains. Though not rapidly abandoned, Amedee's importance began from this moment to decline, eclipsed by the ascension of Wendel. Wendel was more conveniently located as a depot for Honey Lake Valley and when, in 1913, Southern Pacific's Fernley and Lassen Railway crossed the NC&O, the new town achieved the status of an important crossroads.

Amedee was sustained for a while by expectations of irrigation water from Eagle Lake. Since 1876, schemes had been promoted to tap Eagle Lake for the benefit of Honey Lake Valley (Amesbury, 1967; 1971, p. 45-72). With the failure of these projects, the Holmes-Hartson irrigation project of 1910 sought to pump water from Honey Lake up to the dry lands east of Amedee. The project was briefly successful, but after a year's harvest of sugar beets was shipped to Reno via the NC&O, the waters of Honey Lake receded to the point where the system was no longer effective. The abandoned ditch remains visible today.

Again, in 1923, a major effort sought to bring waters from Eagle Lake by way of a tunnel and extensive ditch system. Its success was moderate and brief and its eventual failure, combined with the reduced freight traffic, contributed further to the decline of Amedee. Between 1922, when the narrow gauge line was abandoned for the 16 miles between Wendel and Hackstaff, and 1950, when the town site was sold for back taxes, Amedee lost its population and fell into ruin. Today virtually nothing stands above the ground save the ranch buildings at Amedee Hot Springs.

Even after the extension of the railroad, the town of Wendel maintained some vitality as a railway maintenance station. Several structures are preserved from its early days.

Several histroical sites and monuments lie on national resource lands within the study area:

1. Pearson Massacre Site: The locale of the event has been marked by a sign placed by the California State Automobile Association.

2. Amedee Town Site: A portion of the original town site impinges on an isolated parcel of NRL, but no physical traces are preserved above the ground.

3. Abandoned NC&O Railroad Grade: The elevated bed of the old grade remains visible, crossing three parcels of NRL in the study area.

4. Abandoned Kiln: A construction of hewn tufa blocks lain on a rail framework, this line-slaking kiln (or, by local tradition, 'Hindu oven') was associated with turn-of-the-century railroad activity at the Amedee site.

5. Eagle Lake Ditch: The abandoned irrigation ditch which aimed to bring Eagle Lake water through Honey Lake Valley to the Amedee vicinity meanders across virtually the entire breadth of the study area.

6. Historic Site HS 04-02-1: A homestead east of Wendel, represented now by a scatter of cans and bottle fragments, several excavated pits, two stone alignments, and sparse weathered lumber.

Other historic remains within the study area either fall on private lands (such as the remnants of the 1910 Holmes-Hartson irrigation project) or preserve no physical trace (such as Nobles' Emigrant Trail, which may be inferred to have crossed the northwestern periphery of the study area).

Island Area

a. Archaeological Resources

The peninsula known locally as Honey Lake Island exhibits evidence of human occupancy extending far into the prehistoric era. While in many ecological respects the Island appears not suitable for a great variety of cultural pursuits, at least occasional aboriginal use of the area is indicated by physical remains. The identity of the most recent Native American groups to use the area, however, remains ambiguous, and the technical literature on the subject has not fully resolved the ambiguity. On the one hand, Steward (1966) has advanced the premise (based on data gathered during the Indian Land Claims cases) that the Island constituted the northernmost extent of the territory of the Washoe. On the other hand, Riddell (1960) places the Island within Paiute territory, the boundary of which he extends to Doyle. Riddell's boundary was supported by ethnographic testimony of Washoe and Paiute and particularly by the fact that Paiute informants could name occupation sites within the area, while Washoe informants generally had names only for natural landmarks.

The problem may be ultimately irresoluble, owing to the often indefinite or nonstatic nature of Native American territorial boundaries. The historically observed (and archaeologically confirmed) Great Basin settlement pattern, with seasonal exploitation of a number of geographically distinct and ecologically diverse micro-environments, contributed to a continuous shifting of population centers throughout the year. As a result, a given tract of land might be exploited by more than one group at different times of the year. Riddell (1960, p. 11) identified the Dixie Valley area as one of mutual use by Washoe and Paiute; elsewhere (1960, p. 32) he records that the Paiute frequently invited the Maidu to share the acorn harvest near Milford. Honey Lake Island, therefore, while lying within the bounds of Paiute territory, may well have been exploited even in recent times by both Paiute and Washoe, and it is not unlikely that Maidu groups may have encroached occasionally from the east.

Even less archaeological research has been performed on Honey Lake Island than in the Wendel-Amedee area. Prior to the initiation of the present study, only two prehistoric sites had been recorded there by the California Archaeological Survey, and no excavations had been performed. Although the testimony of local collectors indicated the presence of not inconsiderable archaeological resources, particularly along the water's edge, the prehistory of the Island was virtually unknown. Though in the absence of controlled excavation there are few firm grounds on which to base comparative reconstructions of a prehistoric lifeway, the setting of the study area and inference from other, well-researched, ecologically similar zones in the Great Basin suggests that the Island may have played a significant role in the aboriginal exploitation of lake-margin environments.

In order to identify those archaeological resource which might be adversely impacted by the proposed geothermal development, a professional services contract was let to the Archaeological Research Facility of the University of California, Berkeley, for an intensive, on-the-ground archaeological reconnaissance of all national resource lands within the study area. The reconnaissance consisted of an intensive surface examination with full recordation of all newly discovered sites as well as redocumentation (with newly gathered information) of any sites previously recorded (Busby, 1976). Because the Island environment is much less diverse ecologically than that of the Wendel-Amedee area, and because virtually all tracts of national resource lands have received lease applications, the survey was limited to public lands. No sampling of adjacent regions was performed. The patented lands of lease Application 10 on which mineral rights have been reserved to the government also went unexamined, as the surface owner denied permission to enter for an archaeological survey.

The survey resulted in the identification and recordation of 29 archaeological sites, a density of occupation and usage indicating that the Island's apparently sparse resources did not prove so inimical to the requirements of aboriginal settlement as they have in recent years to white settlers.

Following the classification scheme established in the discussion of archaeologic site categories in the Wendel-Amedee area, (Section II. A. 10. a.) above, the Honey Lake Island sites fall into the following categories:

2. Temporary camps (16 sites)
3. Lithic scatters/chipping assemblages (11 sites)
5. Isolated milling stations (2 sites)

Datable artifacts identified during the survey indicate that the Island saw repeated usage from 2000 B.C. to the Protohistoric era (projectile points are predominantly of the Elko, Martis and Rose Spring series). The occurrence of a possible Northern Side-Notched point and an apparent Great Basin Trasverse point (crescent) may signal an occupancy of very much greater antiquity.

Because all of the identified Island sites are confined to surface manifestations, because their frequency of occurrence is great, and because their surface scatters tend to be diffuse and in several instances quite large, exploitation of the Island seems never to have been intense nor sharply localized. This no doubt owes largely to the ecological homogeneity of the Island's microenvironments; even under pristine range conditions, water would appear to have been the only resource strongly conducive to the repeated settlement of specific sites. Surface materials give little indication of a pronounced lacustrine subsistance base, though formal testing of the hypothesis will no doubt form a major element of future research designs for the area.

While evidence of illicit excavation has not been identified on public lands, few sites on the Island are thought to have escaped the attentions of surface collectors. Several large private collections have been accumulated, particularly from sites along the shoreline. The integrity of most sites has thereby been reduced and much useful information (particularly on the distribution of chronologically and functionally diagnostic artifacts) has been lost.

b. Archaeological Resources of National Register Quality

No individual sites within the study area appear to meet the criteria of eligibility established in 36 CFR 800 for inclusion on the National Register of Historic Places. Although artifact collecting has in general been the only serious impairment of the sites' integrity, the density and abundance of surface materials is quite low. This factor, together with the relative paucity of diagnostic artifacts and the lack of vertical deposits, limits considerably the research potnetial of virtually all sites recorded.

In two instances, however, the co-occurrence of several sites within a restricted area approaches a density of cultural resources which may qualify for nomination to the National Register as archaeological districts. Both will be submitted for formal determination of their National Register eligibility.

1. District 27N, 15E: Within 560 acres of national resource lands occurs the greatest density of archaeological sites identified by the survey effort. Eight sites (five temporary camps, two lithic scatters and an isolated milling station) co-occur with numerous isolated finds lying between site precincts. In addition to the lithic debitage, one occupation site exhibits a large number of ground stone food preparation implements. Survey results suggest that adjacent private lands, particularly to the west and southeast, may host cultural resources as well.

2. District 27N, 16E: On 320 acres of national resource lands lie four archaeological sites, two of them very large size. While the density of surface materials (lithic debitage, chipped artifacts, ground stone food preparation implements) is relatively low, significance is conferred by the occurrence of a Great Basin Transverse Point (crescent), an artifact type of considerable antiquity in the Great Basin (Tadlock, 1966; Hester and Heizer, 1973, p. 12-13). The specimen was not in direct association with the recorded sites and therefore cannot date their occupancy, but implies strongly that these sites merit close scrutiny and may, though confined to surface scatters, yield important research data.

c. Historical Resources

Honey Lake Island has never offered an environment hospitable to modern settlers. Thin soils overlying a chalky substratum and imperfect drainage have conspired to yield a tract of little productivity. Few of those who settled upon it stayed for more than a few years, giving up the game when returns continued to be paltry. Amesbury (1967, p. 21) records one settler's opinion to the effect that "when the Creator made the earth he had a lot of stuff left over with no place for it so he dumped the whole mess forming Honey Lake Island."

Sporadic early settlement was considerably bolstered just after the turn of the century by a land boom lasting over a decade and a half. A new irrigation thrust and an advertising campaign promoted nation-wide attracted a number of homesteaders, none of whom succeeded for long in prolonging their enterprise. While water pumped from Honey Lake enhanced the Island's agricultural viability, it appears to have been not sufficient to override the soils's nutrient inadequacies.

The Island today hosts the remnants of many failed ventures; a few ruined structures of original homesteads are still visible, as are irrigation ditches and the concrete abutments of lakeshore pumping stations. Miles of fenceline, some still standing, cross the area.

On the isolated tracts of national resource lands, only three historic sites were detected during the course of study. All of these closely spaced sites, consisting of fallen wooden structures with scatters of glass, nails, barbed wire, iron fittings and miscellaneous debris, fall within the boundaries of a single homestead entry patented in 1903. It was cancelled in 1912. Reverting then to Public Domain, it typifies the tenuous hold which several generations have attempted to exert over this tract of ungenerous land. The site will be submitted for formal determination of its National Register eligibility.

4. Social and Economic Characteristics

People

This geothermal leasing proposal is contained entirely within Lassen County, California. The Lassen County population in 1975 was estimated to be approximately 18,800 persons (California Department of Finance, 1974). There are no people living on the lands proposed for leasing in this action. There are, however, people living in the vicinity in the communities of Herlong, Wendel, Litchfield, Standish and Susanville. Though some maps may imply the existence of a community at Amedee, this is a ranch residence with one person living there (see TABLE 44).

Susanville is the largest settlement in Lassen County and is the County Seat. It is approximately 26 miles from the nearest proposed lease area by highway. The population adjacent to the proposed lease area is best approximated by Honey Lake census division at 2,853 people (U.S. Bureau of Census, 1970). This division does not include Susanville, but does include the southeastern corner of Lassen County.

The Lassen County population peaked in 1950 at 18,597 and fell to 13,597 in 1960 (University of California and Lassen County, undated). It has now exceeded its 1950 peak and is projected to increase to between 20,700 and 25,700 by 1995 (California Department of Finance, 1974). The difference between projections results from differences in assumptions concerning birth rates and migration.

Community leaders in Lassen County indicate concern over the loss of the young people from their population. This concern is only partially confirmed by the census data however (see TABLE 45). In 1970, the only remarkable difference between the age distribution for the County and the entire State of California was the County's lower percentage in the 20-34 year old group. It is possible that declines in the 0-19 year group were partially obscured by increased enrollment at Lassen Community College in Susanville. In 1970, the median age for residents of Lassen was 1.7 years greater than that of the State. All in all, only the loss in the young working age group is a cause for concern particular to Lassen County. The other observations on changes in the population age are consistent with changes taking place generally throughout California.

The ethnic composition of the County is more homogeneous than the State (see TABLE 46). The population is predominately white. The only ethnic group which is more common in Lassen County than the State is American Indians. Though Indians are common in the County, there are no reservations or rancherias near the proposed lease areas.

In 1969, family incomes and per capita income for Lassen County were substantially below the equivalent statewide measures (see TABLE 47). Per capita income was $2,901 versus the State's $3,521. However, of the State's 57 other counties, 18 of them had lower per capita incomes.

TABLE 44

POPULATION AND PERCENT CHANGE

	1960	1970	(1960-70)	1976
California	15,717,204	19,953,145	+27.0	
Lassen County	13,597	16,796	+23.5	
City of Susanville	5,598	6,608	+18.0	
Honey Lake Division	2,632	2,853	+ 8.4	
Litchfield				35
Standish				45
Wendel				40 (Est.)
Amedee				1
Herlong				900-1,150 (Depending on source of estimate)

Sources: U.S. Census - 1970 and Lassen County General Plan.

TABLE 45

AGE OF POPULATION (1970)

	Lassen County	California
Median Age Group	29.8	28.1
Age Groups		
0-19	37.1%	36.9%
20-34	18.2%	22.0%
35-54	25.4%	23.5%
55-64	10.2%	8.6%
65-Over	9.1%	9.0%

Source: U.S Bureau of the Census, Census of Population: 1970, California.

TABLE 46

ETHNIC GROUPS (1970)

	Lassen County	California
White	94.7%	89.0%
Black	2.2%	7.0%
American Indian	2.3%	0.5%
Other	0.7%	3.5%
*Spanish language or surname	7.8%	15.5%

*The Spanish language - Spanish surname group is not treated as a race in the U.S. Census. Therefore, these people have also been counted in the racial groups listed above.

Source: U.S. Census - 1970

TABLE 47

INCOME (1969)

	Lassen County	California
Family Median	$ 9,248	$10,732
Family Mean	10,032	12,227
Per Capita	2,901	3,632
Family income below poverty level (% of all families)	6.3	8.4
Family income $15,000 or more (% of all families)	16.5	26.7

Source: U.S. Bureau of the Census, General Social and Economic Characteristics: 1970 - California

A much smaller percentage of Lassen County families than families statewide had incomes greater than $15,000. However, in contrast to this, a smaller percentage of Lassen County families had incomes below the poverty level. This indicates that there was less variation among families in Lassen County than was typical for the State, and that these incomes were concentrated at a level lower than the State average. Little has happened to change these relationships since those data were collected in 1970.

Industries and Employment

Unemployment in Lassen County peaks in January or February; it reaches a low in September or October. In 1975, the peak unemployment was 26.4 percent in February; the lowest unemployment was 13.0 percent in September. This resulted in a yearly average unemployment rate of 19.9 percent. 1976 began with a peak of 26.0 percent in February (California Employment Development Department, 1976). Data for the remainder of the year were not yet available when this report was prepared. The County's unemployment rate has increased through the 1960's and 70's.

The largest employment sector in the County is the government, providing an average of 55.2 percent of the jobs in 1975, up from 46.6 percent in 1970 (U.S. Bureau of the Census, 1970). At that time, Lassen County had the highest percentage of government employment of any county in the State. (TABLE 48) The statewide average was 17.8 percent. In addition to the usual State, Federal and local agencies, Lassen County's government sector is bolstered by employees at the Sierra Army Depot at Herlong and the California Conservation Center near Litchfield.

Other noteworthy employment sectors are trade, services, agriculture and manufacturing. In comparison to statewide percentages, Lassen County is very high in agricultural employment and low in manufacturing employment. This is common for rural places.

Production of cattle is the largest component of the County's agriculture industry. Cattle production in 1975 was valued at $5,636,850. Of the $10,642,575 of grain, hay and pasture production reported in 1975 (Lassen County Agricultural Commissioner, 1975), a large part was probably fed to the cattle and also counted in their value. Cattle ranching is the main use of the land in and around the area proposed for lease in this EAR.

Most of the manufacturing employment in the County is in the production of forest products. Two mills at Susanville are the source of this employment. Timber production employment in this area has declined since the 1950's due to exhaustion of the timber resource and technological change in the industry. There are no commercial forest lands in the vicinity of the proposed geothermal leasing.

TABLE 48

EMPLOYMENT - 1975 AVERAGE

	Number Employed	Percent of Total
Agriculture	450	8.5
Construction & Mining	75	1.4
Manufacturing	350	6.6
Transportation, Communication & Utilities	200	3.8
Trade	650	12.3
Finance, Insurance & Real Estate	125	2.3
Services	525	9.9
Government	2,925	55.2
TOTAL	5,300	100.0

Source: California Employment Development Department

The importance of the Sierra Army Depot has been reported in the County's "Overall Economic Development Plan":

> "The Sierra Army Depot, the Army's principal ammunition storage area on the West Coast, is an important and integral part of the County's economy. Following a history of personnel reductions, 1975 saw the first increase in several years. The number of personnel rose from 934 in 1974 to 950 in 1975. Of these, 650 are civilian employees and 300 are military personnel. Additionally, the number of military personnel is expected to increase by 15 or 20 people within the next few months. Approximately 33 percent of the civilian personnel reside in the Susanville area." (Lassen County, June 1976.)

The Sierra Army Depot and Herlong are within a few miles of the Island proposed leasing area.

The California Conservation Center, located between Susanville and Litchfield, is a major employer. This is a minimum security component of the California penal system. Local employment provided by this facility totals 336 positions (Lassen County, June 1976). The Army Depot and the Conservation Center are particularly important to the local economy because they are year-long employers rather than seasonal.

The provision of services for tourists and recreation-retirement properties probably employs 100 to 200 people in the County. Lodging, restaurants and automotive services are largely concentrated in Susanville. Recreation-retirement properties are located in the proximity of the Lassen National Forest. Very little of this activity occurs near the proposed lease areas.

Housing

The development of new housing in Lassen County has stagnated since the decline in the County's lumber industry in the 1950's. The quality and quantity of the County's existing stock of housing has tended to decline since then. The recent (since 1970) growth of the County's population, plus the influx of students to the new campus of Lassen Community College at Susanville, has resulted in a rather tight housing market. The result has been summarized in the Lassen County Overall Economic Development Plan:

> "Because of the shortage of desirable housing within the County, a growing number of families moving into the area have found the only real housing choice available to them is to buy a mobilehome. County building permits back this up. In 1975, over twice as many building permits were taken out for mobilehomes than for framed housing." (Lassen County, June 1976).

The residential area nearest to the Island potential leasing sites is Herlong. Though many of the units there are rentals, the vacancy rate is nil. There are, however, a number of undeveloped subdivision lots in the Herlong area.

Wendel is the residential area nearest to the Wendel-Amedee proposed leasing sites. Wendel is a small residential community with private homes and permanent residents. Many people in Wendel work for the railroad, which serves as a switching point and overnight rest stop for railroad crews. There is room in the community for growth. Housing in Litchfield consists of private homes and a small motel. There is room in the community for additional growth. Much of the housing in Litchfield is relatively new because this has been the location of recent growth. A substantial, but unknown, proportion of the housing units there are mobilehomes.

The area between Litchfield and Susanville, along Highway 395, is recently tending toward conversion from agricultural to single family residential. The housing is newer than the County average, but there are no motels or hotels.

Public Services

High schools are located at Susanville and Herlong. Elementary schools are located at Susanville, Herlong, Doyle, Litchfield, Johnstonville and Janesville. Lassen Community College at Susanville serves the entire area, providing a two-year program leading to an associate degree.

Residents of the Honey Lake Valley have individual wells and septic tanks, with the exception of a part of the Sierra Army Depot. However, Susanville and the Leavitt Lake subdivision provide water and sewer services. There is no natural gas available but electricity and telephone services are provided in all of the communities.

Law enforcement throughout the Honey Lake Valley is provided by the Lassen County Sheriff. This is supplemented in Susanville by the City Police and along the main highways by the California Highway Patrol.

Public health facilities for the area are located at Susanville; the County Hospital and doctor's offices are there. Many residents go to Reno, Nevada, for medical and dental care.

Public Finance

The Island area is in the lowest property tax rate area in the County. The tax rate was $7.97 per $100 of assessed value in the 1975-76 fiscal year. The Island area lies within the Lassen Union High School District and the Lassen Community College District. That school district has a total County assessed valuation of $4,596.949 in 1975-76.

The Wendel-Amedee area was taxed at $8.24 per $100 of assessed value in 1954-76. It is served by the Lassen Union High School District and the Lassen Community College District. That school district has a total County assessed valuation of $6,022,581 in 1975-76.

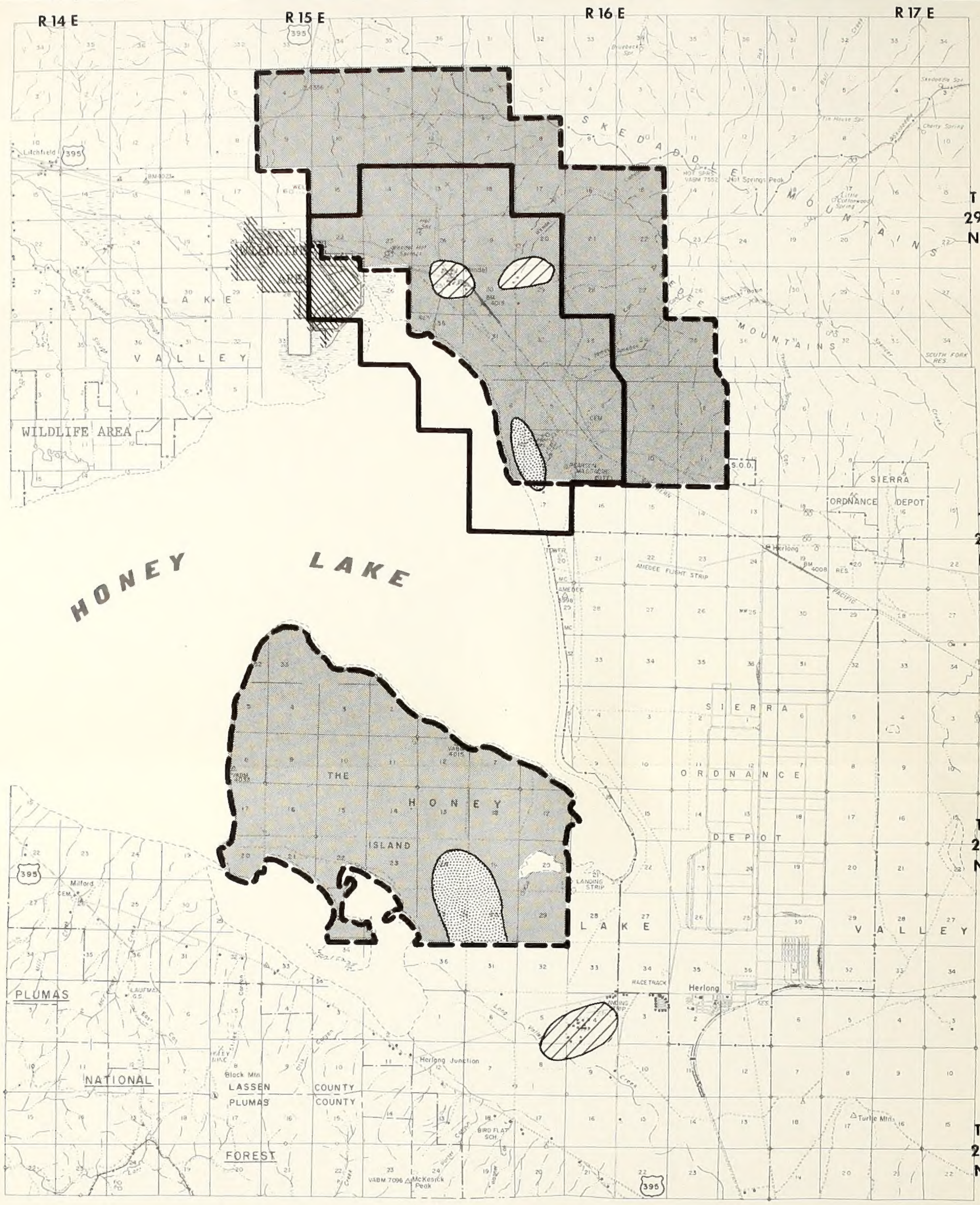
The total gross assessed valuation for Lassen County at that time was $72,799,736. Total funds necessary to operate the County government was $10,654,389 of which approximately 16 percent came from the County's current property tax levy.

Land Use and Local Planning

Public lands in the study area are included within two BLM planning units. Relevant management framework plan decisions have already been discussed in the Proposed Action section.

The Lassen County General Plan, ratified in 1968, shows most of the proposed leasing area as general forest environment or grazing and sagebrush environment. (MAP 27) The exception is the Skedaddle Mountains, which is shown as a prime recreation area. The areas along Highway 395 and a proposed route from Highway 395 to Herlong around the east side of Honey Lake are shown as scenic highway corridors. These corridors extend approximately 1 to 2 miles on each side of the road. Both the scenic highway corridor and the prime recreation area include some of the lands proposed for lease in this analysis.

A significant local planning effort is the Susanville Geothermal Energy Project. This is an ongoing City of Susanville project to explore, develop and control the geothermal resource around Susanville. The City is attempting to implement the concept of the geothermal resource as a city owned and controlled utility. The plan has proceeded thus far with a few exploratory wells and several studies conducted by a consulting firm. Much of this effort has been financed by the Federal government through the Bureau of Reclamation and ERDA.



LEGEND

- Study Area Boundary
- Wildfowl Management Area (Fleming Unit)
- Irrigated Alfalfa
- Residential
- Range Land

MAP-27

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

LAND USE

SCALE: ½" = 1 MILE   MT. DIABLO MERIDIAN

III. ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

Introduction

This chapter describes the unmitigated impacts which could result from implementation of the proposed action. The impact assessment documented below provides the basis for development of mitigation measures, as outlined in Chapter 4. This environmental assessment will address primarily the impacts expected to occur due to maximum development of the proposed Federal lease sites. Models of maximum development are presented which consist of two 100-MW powerplants and two 50 acre agri-industrial sites and necessary support facilities for each lease site. Each resource specialist used a matrix to document the impact of each discrete operation associated with geothermal exploration, field development, production and closeout. The specialists examined maximum electrical development of two-100 MW powerplants and associated support facilities as one possibility (TABLE 13).

A maximum nonelectrical development model was developed based on a 100 acre agri-industrial site (TABLE 16). A discussion of the three candidate activities thought most likely to occur on Federal lease sites is found in Nonelectrical Model Development, Chapter I. Each resource specialist prepared a matrix that analyzed anticipated impacts due to nonelectrical development of each lease site.

Excess electrical power could be transmitted to other regions and hot water could be piped throughout the Honey Lake Valley area for use in private developments. Electrical power development necessary to meet local needs is an alternative to maximum development. \ model assuming one 50 MW powerplant is presented for this alternative (TABLE 14). The addition of one 50 acre agri-industrial site yields an integrated electric and nonelectric model for local needs. Development of geothermal resources underlying Federal lands for nonelectrical purposes would most likely include transportation of hot fluids to utilization points on nearby private lands. This report considers the impacts expected to occur as a result of development on the potential lease sites within the study areas. If Federal leasing is approved and a specific proposal is made for utilization outside the study areas, an environmental analysis of the transportation, utilization points and methods of usage would be necessary before approval is granted.

It is not known at this time whether development will be electrical, nonelectrical or a combination of both. For these reasons separate impact analyses were conducted for maximum electrical development (TABLE 13) and maximum nonelectric development (TABLE 16).

Assessment of impacts associated with electrical and/or nonelectrical development was discussed under three headings. Some resources were amenable to analysis in a very site-specific way (wildlife, archaeology, historical resources) while other resources were best handled in a broader light (geology, socio-economics). It was left to the discretion of each specialist to analyze the Wendel-Amedee and Island areas either separately or combined. The first step of analysis consisted of a discussion of general impacts associated with a resource. This was used as an introduction to more specific impact analysis in the following two steps. The second step of analysis consisted of the following. For each resource critical components were defined by the specialist. Each component was then analysed by tracking it through a series of discrete operations related to stages of development. Impacts were recorded on an impact analysis matrix. For the third step, the specialist would analyze impacts particular to each potential lease unit. Within this framework of general impacts-discrete operation impacts-potential lease unit impacts analysis, it was left to the discretion of the specialist how he included analyses of electrical and/or nonelectrical development.

A. Anticipated Impacts on Non-Living Components

Wendel-Amedee and Island Study Areas

Impacts on geology from each discrete operation on the potential leasing units vary insignificantly in the Wendel-Amedee and Island study areas. The geology of the areas is relatively uncomplicated and will be discussed under the general heading of Geology.

1. Geology

Geothermal development could cause an increase in frequency of natural geologic hazards such as seismicity and ground failure. Other hazards such as subsidence could also result from the development.

The injection of fluids near fault zones has been associated with seismic events in some areas (Healy, et al., 1968; Raleigh, et al., 1975). The conditions necessary for fluid injection to induce seismic activity are existing fractures, critical stress along the fracture plane, and critical pore fluid pressure. The injection of fluids may increase the pore fluid pressure. As such, increased pore fluid pressure has been hypothesized as the mechanism responsible for inducing seismic activity by fluid injection, given that the other two factors are present (Raleigh, 1972).

Geothermal reservoirs are generally at less than or approximately at hydrostatic pressure for a given depth. Fluids can therefore be injected by gravity flow, and this may not necessarily produce excessive pore fluid pressures. The reinjection of fluids into geothermal reservoirs has been practiced at The Geysers, California, the Valles Caldera, New Mexico, and the Imperial Valley, California (Chasteen, 1974). At The Geysers, a vapor-dominated system, 3.15 X 10^9 gallons of condensate were injected over a period of six years. The initial reservoir pressure was at 500 psi. At the Valles Caldera, a liquid-dominated reservoir, 10^8 gallons of fluid were reinjected over approximately a one-year period, and at the Imperial Valley, another liquid-dominated reservoir, 1.26 X 10^8 gallons were reinjected during 1964 and 1965. In all three cases there has been no report of increased seismicity.

Should increased seismicity occur as a result of geothermal development, ground failure could become more frequent. Although ground failure due to liquifaction is less common for seismically active areas, increased seismicity could cause ground failure due to the unstable character of slopes composed of unconsolidated material.

The withdrawal of large volumes of fluid from unconsolidated sediments may cause subsidence. This is particularly true in fluid-dominated geothermal resources, as Wendel-Amedee appears to be. There is a possibility that subsidence could affect marsh management at Honey Lake Wildlife Area and surrounding farm areas where dikes, water structures, ground level and slope are very critical.

Geologic, geophysical, and exploratory drilling in the proposed area would bring to light scientific knowledge about the subsurface geology of a largely unknown area. Many geologists have postulated that the rocks underlying the volcanic rocks of the Modoc Plateau are similar to those in and adjacent to the rocks in the neighboring Klamath and Sierra Nevada Mountains. If so, a vast potential for mineral deposits exists which could someday add to our Nation's dwindling mineral reserves and wealth. In addition, spin-off data resulting from geothermal exploration would be of immense value to the geologic community. New knowledge of geologic history, seismicity, earth structure and the origins of mountains and continents would emerge. Also with each new geothermal development, new data are gathered and new technologies developed so that the potential for adverse impacts such as induced seismicity or subsidence is lessened.

Impacts associated with seismicity, slope instability and subsidence are similar for all potential lease units. Since no site-specific geologic hazards have been identified for any of the 11 potential lease units, an impact analysis matrix was not required for either electric or nonelectric development. Potential surface and subsurface impacts associated with nonelectrical development will be considerably less than electrical development, primarily because fewer wells should be necessary to develop a nonelectrical complex.

2. Soils

Wendel-Amedee and Island Study Area

a. General Impacts

The construction of roads, drill pads, disposal wells, disposal ponds and off-road vehicle use will crush and remove vegetation from 28 acres during exploratory drilling (TABLE 7) and 318 acres for a fully developed 2560 acre lease (TABLE 13). The total surface disturbed is approximately 12 percent of a fully developed 2560 acre model base area. Potential negative impacts expected are influenced by the steepness of topography and soil stability associated with each particular construction site.

Bare exposed soils as a result of the removal of vegetation in the study areas are susceptible to wind erosion during the dry summer season and to water erosion during the spring season. Soil losses may amount to 0.5 inch or more per year where soils are continuously disturbed by equipment. The success of revegetating exposed bare soils on the foothill or mountain areas will be the single most important factor preventing accelerated soil erosion.

Soils compaction on wet areas would break down soil structure for many years after vehicle travel has ceased. Wheel tracks on slopes of the foothills and mountain areas could collect water and cause severe gully erosion.

The loss of ground cover on steep slopes will cause accelerated soil erosion. Both sheet, rill and gully erosion is expected if revegetation is not successful.

b. Discrete Operations (Electrical and Nonelectrical)

Preliminary Exploration. No adverse impacts are expected from air or foot travel.

Off-Road Vehicle Use. Off-road vehicle use is expected to compact soils and crush or kill vegetation which will alter soil structure and vegetation in small areas. ORV use in foothill and mountain areas having steep slopes and erosive soils could experience negative impacts. The level valley basin soils are stable, heavy impermeable clays on which no negative impacts are expected.

Exploratory Drilling and Field Development. This operation entails construction of roads, drill sites, ponds, pipelines, and building facilities.

Well sites located in steep and rough terrain may have a severe effect on the landscape. These well sites usually display a steeply cut back slope and a long, steep front slope. The resultant land features are abrupt edges, unusual land forms, benches, and unnaturally steep slopes that are often prominently displayed. The exposed subsoils, rock and eroded slopes contrast significantly with the adjoining undisturbed areas. These well sites are also expensive to construct; the disturbance to the surrounding area is usually in excess of the amount required to drill and maintain a well. In addition, these well sites are usually highly erodable, and difficult and costly to rehabilitate.

Access roads may create greater adverse impacts to the land surface and influence a considerably larger area than a well site. The initial access road to an exploratory well site can be constructed as a temporary road with plans towards its eventual closure and total rehabiliation. Most of these roads will eventually be abandoned and usually have little residual value for future access. If not closed and reclaimed, these roads require considerable upkeep to sustain a usable condition. In most cases the amount of use they receive does not justify the maintenence required and eventually become unusable due to deterioration from erosion.

Similar to well sites, roads constructed on steep hillsides require an extensive amount of dirt work in an area where the natural steepness may not allow the graceful or stable deposition of fill. Side hill roads have been compared to contour mining, a practice under considerable criticism, in which spoil material being removed from the cut is cascaded down the hillside until a semi-stable slope is achieved. Both cut and fill slopes continue to erode, slide and slough off until the entire hillside may be affected. Side hill roads collect large amounts of runoff from the uphill side which if not dealt with properly, gullies the road-bed, slopes, and barrow areas.

Entering an area and constructing a road during muddy conditions usually results in considerable damage to the land surface. Large amounts of soft materials are bladed to the side of the road to provide a firm road bed. Areas adjoining the road bed and well site become rutted and torn up by construction equipment and vehicles. Road widths should be kept to a minimum, consistent with the access requirements

Field development is much the same for electrical and nonelectrical operations. The primary difference is in the acreage required for the two types of development.

<u>Drilling and Well Venting</u>. Gaseous emissions from wells are not known to have a negative impact on surface soils.

<u>Well Testing and Waste Disposal</u>. Geothermal fluids may be of a heavily mineralized nature. With properly constructed ponds or reinjection wells, no adverse impact is expected. A blowout or faulty settling pond could cause accidental spills of the fluids. The fluids would flow over the ground surface sterilizing the soils and

killing the vegetation it contacts. This would constitute a high negative impact. To develop 2-100 megawatt electrical energy powerplants the vegetation will be removed from approximately 318 acres or 12 percent of a lease unit (TABLE 13) for construction of raods, drill sites, pipelines, ponds, and buildings, etc. For nonelectrical development, a 136 acre agri-industrial model uses 5.3 percent of a lease area (TABLE 20). In both cases the unprotected area would leave soil exposed to the erosional forces of wind and water.

Production (Electrical and Nonelectrical). Once the facilities have been established, electrical and nonelectrical production will have very low, if any, negative impact.

Close-Out. The overall effects on soil of the close-out of a geothermal field could be beneficial. However, some wind and water erosion may occur as a result of the soil disturbance while dismantling the equipment. Beneficial impacts would include new uses for improved access, power sources, and potential increase in usable water sources. Generally the beneficial aspects of close-out rehabilitation measures are expected to greatly outweigh the negative impacts of a close-out operation.

c. Potential Lease Units

Lease units numbers 1, 2, 3 and 5 are completely covered by soils 419, 4063 and 4064, which are highly succeptible to soil erosion (MAP 10 and Appendix 4). Lease units numbers 4, 6 and 7 are partially covered by the same soils. The foothill slopes start from five percent and increase to 75 percent in the mountain areas. The magnitude of impacts is proportional to the steepness of the mountain slope. These soils are located in the recharge area identified on MAP 10. Development in the recharge area would cause increased soil erosion which would cause increased sedimentation. Increased sedimentation would adversely affect percolation of water into the underground aquifers by sealing off porous soils with fine sediments.

The remainder of lease units numbers 4, 6, 7 and all of lease units numbers 8, 9, 10 and 11 are covered by soils (420, 423, 425 and 426). These soils lie on relatively flat slopes (0-5%) and are very impermeable to water penetration. Therefore, adverse impacts are expected to be low because water run-off is uncommon and soil erosion is minimal. These lease units act as settling areas for sediments carried from the foothill or mountain areas.

For a more detailed analysis of impacts associated with each discrete operation, refer to TABLES 52 and 53.

3. Water

Wendel-Amedee and Island Study Areas

a. General Impacts

Exploratory drilling, development, and operation stages could have adverse effects on surface and subsurface water sources. Explosive charges occasionally used for seismic surveys detonated near springs and wells could seal off and stop the water from flowing.

Fractured well casing, or blowouts could allow toxic chemicals and brine to mix with underground fresh water sources. Improperly constructed settling ponds in the foothills and mountains could allow toxic chemicals and brine to enter the underground aquifers. In each case the affects are longlived and the problems of pollution would linger for an extended period. The future use of the ground waters for domestic or irrigational purposes may cease.

b. Discrete Operations

Preliminary Exploration

Airborne and Surface Reconnaissance. Few impacts are expected from reconnaissance by aerial or foot travel in relation to water resources.

Off-Road Vehicle Use. Assuming that only limited off-road vehicle use is expected, impacts upon water resources would be low to moderately negative. Some increased surface run-off would be expected as a result of additional bare ground created by off-road vehicle disturbance. Wheel tracks on slopes may collect water from surface flows, which would cause accelerated soil erosion in the foothill and mountain areas.

Exploratory Drilling

Road Construction and Use. Road construction initiates conditions temporarily conducive to erosion, compaction and landslides. Road construction usually involves the removal of topsoil. If cast aside, the material is often the source of stream sediment.

In difficult terrain, road construction is a necessary part of the exploration phase of geothermal development. Access must be gained to bring in drilling and other equipment for evaluation of the energy resource. Road and trail construction involves the cutting, filling and grading of surface materials. Bulldozers are commonly used. This operation not only removes vegetation, it creates cutbanks and fills of loose soils that are susceptible to erosion from water run-off. In areas where small streams (Wendel Creek, lease Unit number 6) or gullies are not bridged, surface water is redirected to new channels which cause build up of flowing waters that may wash out the small gully plugs and send large amounts of silt down stream. Moderate negative impacts are expected.

Drill Site Development. Preparation of the drill site, where necessary, has the same result as road construction. The exposed soil is subject to wind and water erosion. The increased soil sedimentation degrades the quality of surface water run-off. The impacts are expected to be moderate.

Drilling. Well drilling only affects the underground water resources. The drill holes may penetrate several ground water aquifers. It is possible that the hole would allow different qualities of water to mix. The deeper geothermal fluids could also mix and pollute valuable ground water basins. If properly constructed no negative impacts are expected. If aquifers containing poor quality water are not sealed off or if casing ruptures, high negative impacts would result.

Well Testing. Well testing necessitates the use of a settling pond (4 acres) for storage of waste fluids. Many trace mineral elements including mecury, led, cadmium, flourine, boron and manganese are found in the waste fluids. These trace elements, if allowed to percolate into the underground aquifers from the recharge areas or spill and flow over the ground surface, could cause ground water to become toxic. With proper removal of waste fluids no negative impacts are expected. However, high negative impacts are expected if geothermal waste fluids accidently spill and leach into the shallow aquifer.

Field Development

Intensive Well Development. A geothermal field fully developed for the production of electrical energy will require 231 acres or nine percent of a total lease unit to be cleared of vegetation. Similarly a fully developed geothermal field for nonelectrical production will require 130 acres or 5.1 percent of a lease unit to be cleared of vegetation.

For both electrical and nonelectrical field development, impacts are similar to those previously discussed for drill site development, drilling and well testing.

Well Venting. No impacts to water resources are expected.

Waste Disposal. Reinjection of geothermal fluids pose the same hazard as well drilling and use. If by accident the toxic chemicals of the waste fluids enter fresh underground waters, the usefullness of the fresh water would be eliminated. A high negative impact would result if a reinjection well is not properly constructed.

The potential exists to remove the toxic chemicals from the waste fluids. The water could then be used for irrigation purposes. Assuming that the waste fluids were fit for irrigation purposes, 66 acre feet of waste water produced each day from a lease during maximum operation of 40 wells (TABLE 13) could water alfalfa on nearly 500 acres by flooding or 1860 acres by sprinkling. As a result the agricultural industry within the study areas would be greatly enhanced. This would be a high positive impact.

Pipeline Development. A fully developed field would require 78 acres to accomodate the right-of-way for 65 pipelines used to carry steam from wells to power plants (TABLE 13). No adverse impacts are expected for water resources.

Production of Energy. Once the facilities have been established, electrical and nonelectrical production will have low negative impact.

Close-Out. The removal of equipment and well preparation for abandonment will have very low negative impacts. Surface reclamation will have a positive overall affect on water resources.

c. Potential Lease Units

During well drilling on all units, it is possible to cause mixing of the surface water run-off with the waste fluids if a settling pond breaches and discharges onto the surface. If a settling pond located in a recharge area ruptures, the toxic wastes would percolate through the soil and enter shallow aquifers. During drilling operations underground waters could be mixed with toxic waste fluids because of fractured casing.

Potential Lease Unit #1. This 760 acre unit is situated in the foothill area. Approximately 40 percent of the unit would be impacted from a moderate to high degree from full development because it is located within the recharge area. The remaining 60 percent is situated outside the recharge area (MAP 10). It would have low to moderate adverse impacts.

Potential Lease Unit #2. This 1,120 acre unit is 90 percent in the mountain and foothill recharge areas. Here all phases of exploration, field development and production of geothermal resources could have a moderate to high negative impact on surface run-off and ground waters.

In the remaining 10 percent of the unit, full field development has a low adverse impact because of the levelness of the area and heavy clay soils with low soils permeability.

Potential Lease Unit #3. This 641 acre unit is located in the steep foothill and mountain areas. Nearly 100 percent of this unit is located within the recharge area (MAP 10). Impacts in this lease unit will be similar to those listed in lease Unit #2.

Potential Lease Unit #4. This 320 acre unit is located in the valley floor outside the recharge area. No adverse impacts are expected if well drilling, well development and waste disposal units are properly constructed. This land is privately owned with the exception of the mineral rights, which have been retained by the United States Government.

Potential Lease Unit #5. This 1,205 acre lease unit is located in the foothill area. Nearly 80 percent of this unit is located within a major recharge area (MAP 10). This area would expect to have low to moderate negative impacts from full field development, because of the capability of surface waters to mix with underground aquifers. Impacts in this lease unit will be similar to those discussed in lease Units 2 and 3. The remaining 20 percent of the unit is situated in a level area where impacts are expected to be low to moderate.

Potential Lease Unit #6. This 1,322 acre lease unit located near the town of Wendel has about 50 percent of the unit located in the valley floor and 50 percent in the foothills. Only minor portions of this unit are within the recharge area (MAP 10).

Moderate to high impacts would be expected with respect to Wendel Creek if any construction impedes natural surface run-off. The obstruction will cause water to be diverted creating a new stream channel. The increased sediment load from channel cutting will decrease water quality.

Potential Lease Unit #7. This 1,600 acre lease unit has about 30 percent of the area located on the steep mountain slopes and 70 percent near level valley lands. The mountain area (30%) is within the recharge area which will have impacts similar to those discussed in lease Units 2 and 3.

The flat area (70%) would have low negative impact from full field development and production of geothermal energy. Refer to impacts listed in lease Unit 4.

Potential Lease Units #8, #9, #10, and #11. These four (4) lease units combined have 4,044 acres of land all located on the Island area adjacent to Honey Lake. These lease areas are mostly flat, with low soil permeability. Refer to impacts as discussed in lease Unit 4.

Part of lease Unit #10 (874 acres) is now in agricultural production where the land is privately owned but the United States Government has retained all mineral rights.

One Bureau of Land Management well exists on lease Unit #10. This well is used to water livestock during the fall and winter grazing season. If the shallow water table, which it taps, is lowered or polluted by toxic geothermal fluids, this well will become useless.

For a more detailed analysis of impacts associated with each discrete operation, refer to TABLES 54 and 55.

4. Air and Noise

Since air and noise quality varies insignigicantly between the Wendel-Amedee Area and the Island areas, impacts on air and noise from each discrete operation will generally be of the same degree in each area. Analysis of those impacts will be discussed in two categories. The first will deal with the entire Wendel-Amedee/Island study area and will consider two environmental units, air and noise. The second will consider impacts in those environmental units on a potential lease unit basis. In each case, impacts accruing from energy production and those resulting from nonenergy-related development will be considered.

Wendel-Amedee and Island Areas

a. Electrical Production

Air

Air Movement Patterns. The only impacts expected upon air movement would be a slight impact on the micro-air movement patterns. Structures such as powerplants, powerlines, and pipelines could cause a change in air movement patterns in their immediate vicinity but would have no influence on the overall air patterns.

Temperature and Humidity. Powerplant development and use may affect the temperature and humidity of the air in the immediate vicinity of the geothermal plant complex.

The degree of the impacts would be dependent on the extent of development of the geothermal areas. Under full development, with several powerplants, many miles of steam pipes, and steam emissions into the atmosphere from cooling towers and well vents, the air temperature and humidity around the geothermal complex could increase.

Increased temperatures could have some impact on wildlife and vegetation in the immediate area. The impact is expected to be low since temperature increase should be slight with the temperature change dissipating to the normal range within a few miles of the geothermal complex.

The influence that a concentration of geothermal plants has on the overall humidity is expected to be slight with any increases dissipating to existing levels within a few miles. During early morning hours and winter months, the increased humidity and venting of steam into the atmosphere may cause a local fog hazard.

Particulate Matter. Patriculate matter will be increased by all discrete operations that involve vehicle traffic across unpaved roads. The amount will vary depending on the soil type, moisture and amount of vehicular traffic.

Major construction projects such as road construction, drill-site development, and powerplant construction that require vegetation removal and movement of earth will increase particulate matter. The scope of the impact depends on the number of construction projects occurring simultaneously. At maximum development of the two lease areas, a total of approximately 1,500 acres, would be disturbed.

Particulate matter will also be increased by windblown dust from areas exposed by vegetation removal. The degree of this impact on the overall air quality is lessened by the fact that under existing conditions a considerable amount of dust is blown into the air during high winds. The exposed dry lakebed of Honey Lake and areas of sparse vegetation contribute a significant amount of dust to the atmosphere during these winds with the community of Herlong suffering most. Honey Lake has about 60,000 surface acres, of which about half will become dry during an average summer. The lake became completely dry during the summer of 1976. Assuming that a yearly average of 1/3 of the lake's surface area were dry, about 20,000 acres of soil surface would be exposed. Considering maximum development of all leasing units, about 2,000 surface acres is expected to be disturbed. Not taking into account the sparse vegetation, maximum development would account for an increase of a maximum of 10 percent in particulate matter.

Surface rehabilitation by revegetation will decrease the windblown dust, having a beneficial effect on air quality.

Noxious Gases. There will be an increase in noxious gases emitted into the atmosphere from internal combustion engines due to the increase in vehicular traffic during all stages of development.

The degree of the impact will depend on the number, size and concentration of vehicles along with atmospheric conditions and air dispersal rates.

The air dispersal rate should be good during most periods but inversion layers do occur over the area for periods of one or two days and would tend to hold noxious gases in the Honey Lake Basin.

At maximum development of the area, the impact from increased emission of internal combustion engine gases into the atmosphere is expected to be very low and within State and Federal standards.

Noxious gases associated with geothermal wells will also be emitted into the atmosphere as new wells are dug and vented, and powerplants are put into operation. The exact nature of noncondensible gases emitted into the atmosphere from the geothermal reservoirs in this area is not known since very little is known about the reservoir or its extent.

Venting of geothermal gases and vapors into the atmosphere occurs during production testing of wells, bleeding of wells prior to connection to powerplants, from gas ejector vents on condensers, and from cooling towers.

Noxious gases and vapors generally make up less than 3 percent of the total gas fraction of geothermal systems. TABLE 9 lists gases in volume percent associated with five operating geothermal fields. Air pollution and health hazards are possible if large amounts of uncontrolled venting to the atmosphere occur for sustained periods.

Carbon dioxide in undiluted geothermal steam is present above toxic levels. If CO_2 is collected in topographic depressions or unventilated work areas, danger to animals and men will result.

H_2S is toxic to man and animals and, when oxidized to SO_2 and SO_3 in the atmosphere, is injurious to vegetation. Both oxidation products can dissolve in precipitation and return to the earth as acid rain. Accumulations of H_2S are known to cause injury to crops. Perhaps the most obvious impact on air quality would be the rotten egg smell of H_2S that would be released into the atmosphere. As an example, in The Geysers area prior to generation of electricity, drilling and subsequent well testing have released such gaseous vapors. During production testing after each well was completed at The Geysers (about 3 days), about 265 pounds of H_2S per day is released. After this, the wells are shut in until production. However, it should be noted that due to the different nature of the geothermal resource in the project area as opposed to The Geysers, the H_2S releases discussed above may not be relevant.

Radon in noncondensible gases may cause occupational hazards to workers. The effects of radon on plant and animal communities are unknown but presumed small because of large terrestrial contributions by natural sources. Studies to date in The Geysers have not resolved questions about the extent of radon impacts but are still being continued at this time.

Mercury is a known constituent of some geothermal fluids and may be present in sufficient quantities to pose a health hazard. The compounds of mercury are dispersed throughout rocks, soil, air, water, and living organisms by a complex system of physical, chemical and biological controls. Mercury vapor is generally washed from the atmosphere by rain and can be incorporated into the tissues of organisms in the aquatic environment and, secondarily, into terrestrial predators. Mercury may accumulate in the bodies of living things by way of the food chain, or by direct assimilation from the surrounding medium. If it accumulates in sufficient concentration in living tissue, it can be toxic and eventually lethal.

Any accidental discharge of steam due to the rupture of pipelines or a well blowout will yield gases and vapors to the atmosphere. The quantity of noncondensible gases and vapors released by such an accident may be

TABLE 9

EXAMPLES OF GASES ASSOCIATED WITH
VARIOUS GEOTHERMAL SYSTEMS

	Geysers 1/ California	Larderello 1/ Italy	Matsukawa 2/ Japan	Namafjall 3/ Iceland	Wairakei 4/ New Zealand
H_2O	98.045	98.08	99.87	99.43	
CO_2	1.242	1.786	0.18	0.18	0.06
H_2	0.287	0.037	0.01	0.19	0.001
CH_4	0.299			0.01	0.0005
N_2	0.069	0.0105		0.05	0.0003
A			0.03		
H_2S	0.033	0.049		0.14	0.004
NH_3	0.025	0.033			0.0008
H_3PO_4	0.0018	0.0075			
C_2H_6					0.0001
H_3BO_3					0.00001
HF					0.000016

*Table adapted from "Final Environmental Statement for the Geothermal Leasing Program," U.S. Dept. of the Interior, 1973, Vol. 1, p. III-13.

1/ White, D. E., Muffler, L. J. P., and Truesdell, A. H., 1971, Vapor-dominated Hydrothermal Systems Compated with Hot-Water Systems; Econ. Geology, V. 66, p. 75-97.

2/ Nakamura, H., Sumi, K., Katagiri, K., and Iwata, T., 1970, The Geological Environment of Matsukawa Geothermal Area, Japan. U.N. Symposium on the Development of Utilizatior of Geothermal Resources, Pisa, Italy.

3/ Lindal, B., 1970, The Use of Natural Steam in a Diatomite Plan, U. N. Symposium on the Development and Utilization of Geothermal Resources, Pisa, Italy.

4/ Axtmann, R. C., 1975, Environmental Impact of a Geothermal Power Plant; Science, Vol. 187, No. 4179.

no greater than if the steam were passed through a powerplant and the gases released to the atmosphere through cooling towers and gas ejector vents. Gas extraction processes installed at power plants could concentrate gases and vapors which, if accidentally discharged, could increase the concentration of pullutants to the atmosphere.

Noise

An increase in the noise level can be expected from all phases of development that entail vehicles and heavy equipment movement. The intensity of the impacts from these vehicles is expected to be low.

The noise level can be expected to increase from most activities of geothermal development. The major activities contributing most to increases in the noise levels are the actual well drilling process, well testing and steamline venting. TABLE 10 shows a comparison of noise levels between development of The Geysers Geothermal Area and other noise sources.

The higher noise levels shown in TABLE 10 can be detrimental to human health and comfort for those individuals in the immediate vicinity of the operations. The impact of the increased noise level on humans in surrounding areas is lessened by the distance of any concentrations of population from the noise source.

Most operations that cause increased noise levels occur for short periods thus lessening the overall impacts. With the full operation of a plant, activity is expected to decrease thus decreasing the noise level. There will continue to be new well development, testing and steamline venting.

The increased noise levels created by the various stages can also be expected to disturb wildlife in the area. Some animals in the area will possibly move to surrounding areas away from the noise and activity where others will be relatively undisturbed. The intensity of this impact is lessened in the fact that noise levels of the intensity listed in TABLE 10 and higher from the Sierra Army Depot Demolition Site already exist in the area.

The impacts on wildlife are considered more thoroughly under the wildlife portion of this EAR.

TABLE 10

NOISE

Activity	Noise Level dB(A)'
Air Raid Siren (100')	130
Steam exiting a Blow Line during Clean-out and Testing (50')	125
Jet Aircraft (200')	120 Threshold of pain
Amplified Rock Music (5')	110
Off-road Motorcycle (50')	90-105
Drilling Rig (air) (50')	102
Power Mower	100
Unmuffled Diesel Truck (50')	100
Truck Traffic Bringing Equipment and Supplies (50')	100
Steam Exiting a Blow Line with Muffler (50')	89-100
Road Building Equipment (50')	80-90
Steam Generating Plant (50')	85-90
Inside City Bus	90
Motorcycle-2-Stroke Muffler (at source)	80 Danger Level
Pneumatic Drill (50')	80
Major Urban Freeway (100')	75-80
Street Corner in Large	75
Vacuum Cleaner (10')	70
Normal Conversation in Large Store	60

TABLE 10 (Continued)

Activity	Noise Level dB(A)'
Interference with Sleep	55
Business Office	50
Average Residence, Quiet Room	40
Residential Area at Night (average)	40
Soft Whispers (5') Tick of Watch (2')	30
Studio for Sound Pictures	20
Leaves Rustling in Wind	10

Adapted from:

1. Final EIR, Vol. 3, Davies Estate in Lake County ENVIRONS, Las Altas, California.

2. ED & T 2428 Noise Reduction of Forest Service Equipment, USDA, Forest Service, San Dimas, California 91773.

3. ____________________ 1976, In Environmental Analysis Record, Randsburg, Spangler Hills, South Searles Lake, Proposed Geothermal Leasing. USDI, Bureau of Land Management, Riverside District, California.

4. Procunier, 1976.

b. Nonelectrical Production

Air

Particulate Matter. All impacts associated with development of the geothermal field for nonelectrical production will be the same as for development for electrical production through preliminary exploration and exploratory drilling since the discrete operations are the same for both.

During field development, those discrete operations that increased particulate matter in the air with development for electrical production will also have an impact on the air during development for nonelectrical production but to a much less extent since only five wells are developed for nonelectrical production instead of the 65 associated with electrical production. These impacts are primarily windblown dust from areas denuded of vegetation for wells, plants and pipeline construction.

Noxious Gases. The impacts from gases vented into the atmosphere from the geothermal wells are not known since the exact nature of the geothermal reservoir is not known. The impacts occurring during drilling, well testing and venting, if any, will be much less than with electrical production since there will be only three wells per lease site instead of 40.

No impacts from noxious gases are expected during the production stage since nonelectrical production deals mainly with closed hot-water systems with a very limited amount of steam being vented into the atmosphere.

Noise

Although the noise levels produced during drilling, well testing and venting are the same, the impacts are considered slightly less than those associated with the electrical production model since the number of wells is much less for nonelectrical production, thus decreasing the duration of noise and the number of wells being tested, vented and drilled at any one time.

Since with nonelectrical production there will be no powerplant, noise impact during the production stage should be greatly reduced and almost nonexistent.

Wendel-Amedee Area - Potential Leasing Units 1-7

a. Electrical Production

Air

The particulate matter and noxious gases contributed to the atmosphere by the wells on individual leasing units should not vary significantly from leasing unit to leasing unit since all wells will be similar and production should be from the same geothermal reservoir.

There may be some variation of impact on air quality due to increased particulated matter as soil types vary. The potential leasing units (1, 3, 4, 5, 6, 7) on or partially on alkaline deep soils will probably contribute more particulate matter to the air since these soils are more susceptible to wind erosion.

The intensity of the impact of windblown dust from these denuded sites is lessened due to sparsely vegetated areas on these soil types and a large expanse of bare alkaline soil surrounding Honey Lake on the windward side of the leasing areas.

At maximum development of the six potential leasing units (1, 3, 4, 5, 6, 7) and allowing 40 wells per lease site approximately 720 acres would be disturbed. During periods of high winds this would not add significantly to the particulate matter gained from Honey Lake and sparsely vegetated areas. There is a corridor extending from Honey Lake downwind several miles where State air quality standards for particulate matter are exceeded on windy days and an increase of 720 acres of surface exposure will add only slightly to this.

Potential leasing Unit 2 and portions of Unit 7 are located on very steep, rocky, thin and sparsely vegetated soils and would probably contribute slightly less particulate matter to the atmosphere than the other leasing units.

The humidity contributed to the atmosphere by the wells (in the form of water droplets) would have some impact on the atmosphere. During production and operation at full development of all potential lease units 1-7 a maximum of 70 acre-feet of steam could be vented into the atmosphere per day. The full impact of this is not known. This amount of steam could change the relative humidity of the area depending on weather conditions and dissipation of air.

There is an impact on air quality from all discrete operations that involve venting steam from the geothermal reservoir into the atmosphere. These operations are primarily well testing, well venting and production.

The impacts from noxious gases are not known since those present and the amounts of each are not known. Noxious gases present in toxic amounts could be detrimental to plant, animal, and human life.

In referring to five other geothermal developments (TABLE 9) and the various gases associated with them, indications are that the impacts on the air quality in the Wendel-Amedee and Island area will be low to moderate but as mentioned above, the exact impacts expected cannot be known until all gases associated with the reservoir are known. The highest impact expected in referring to other geothermal areas would be from the hydrogen sulfide emitted into the atmosphere.

Impacts outside the leasing units for air will generally be the same as impacts inside the leasing units. The impact would be slightly greater on the leeward (NE) side of the leasing units since prevailing winds would carry the air in this direction.

There would be some impact on wildlife if noxious gases were emitted into the atmosphere in toxic amounts. This would also be detrimental to humans. With particulate matter and noxious gases dispersing with distance, the impact also decreases with distance.

The only populated area nearby whose air quality is expected to be impacted is Wendel, with a population of about 25. Leasing Units 4 and possibly 5 could have an impact on the air in the vicinity of Wendel. Leasing Unit 6, lying closest to Wendel, could have an impact on the air quality although Unit 6 is downwind from the prevailing winds.

During periods of inversion layers, all leasing units would have the same impact upon the air quality since all are within the Honey Lake Basin. The impact on the air quality from a single leasing unit is expected to be slight.

Except for possible funnelling of air in canyons and the concentration of noxious gases under inversion layers, impacts outside each potential leasing unit will decrease with distance from the leasing units.

Noise

The impacts on noise come primarily from heavy equipment activity and to a greater extent from well drilling, well venting, and well testing. The greatest impact is from the drilling operation and to a slightly lesser degree, the testing and venting activities.

The impacts vary little from lease unit to lease unit since most development will be on the relatively flat regions of each lease unit, which will put most of the development in the same general wildlife habitat type. Development close to the base of the Amedee Mountains may cause some deflection of sound, increasing the impact slightly from that of development in more open flat areas.

The impact upon humans is the same on all leasing units since the same activities occur on each. The impacts depend on the distance from the source.

Impacts outside each leasing unit from well drilling, testing and venting were considered to be slightly different among leasing units. The impact from Potential Leasing Units 1 and 5 were considered low since portions of them are in the open flats and portions are bisected by a railroad. The off-site sound level should not be of much greater intensity than that presently caused by the railroad. The off-site impacts on Potential Leasing Unit 2 are considered greater because of its close proximity to important raptor habitat.

The impacts on Leasing Units 3 and 7 outside these leasing units could also be considered low because of existing noise levels. The close proximity of the Sierra Army Depot demolition area to Units 3 and 7 and the existence of the railroad on portions of Unit 7 could decrease the degree of the impact that well development on the sites could have on surrounding areas. The impact could be increased greatly if plants were located near the cliffs that support 24 raptor habitat but it is not known what impact this lesser constant noise will have over an intermittent louder noise.

No data were available on levels of noise disturbing to wildlife. The impacts upon wildlife from noise will probably be less than the impact caused from the increased human activity and actual development of the area.

The impacts resulting from development on Potential Leasing Unit 4 are also considered slightly greater than those of Units 1 and 5 because of their nearness to the Fleming Wildlife Area. Depending on where development on the leasing units takes place, well development may not produce any higher noise level on the periphery than the railroad nearby, but the noise may be for longer periods than under existing conditions.

The impacts on wildlife are handled more thoroughly under the wildlife portion of the EAR. As stated earlier, the primary impact upon wildlife will be from the human activity and development along with habitat loss. Those wildlife not disturbed to the extent of leaving the area by initial development will usually be of sufficient distance from the well sites to be undisturbed by the noise.

The impacts from Potential Leasing Unit 6 are also considered slightly greater than Units 1 and 5 because of its nearness to the community of Wendel. Since this unit varies from 1/8 mile to 2½ miles from Wendel, the impact will vary depending on where wells are located.

At 1/8 mile, the drilling operation could produce 100 decibels, whereas at 2½ miles from Wendel it could be about 75 decibels, a difference of 25 dB. Taken on the A weighted measure system, indications are that the difference would be much greater. A drilling operation produces 126 dB(A) at 25 feet and 55 dB(A) at 1500. Calculating on out to 2½ miles, the level could be as low as 36 decibels.

The noises that are apparent in Wendel now result mainly from the Sierra Army Depot demolition site which could produce a maximum level of about 135 decibels (10,000 pounds of explosives with unobstructed travel of sound) and the railroad which would produce about 45 decibels at one-quarter mile.

b. Nonelectrical Production

Air and Noise

The site specific impacts associated with nonelectrical development are very similar to those associated with electrical development.

Discrete operations that involve removal of vegetation (road construction, drill site development, plant construction and pipeline development) and travel across unpaved roads contribute most of the particulate matter to the air.

Impacts from noxious gases, although not known since the noncondensible gases are unknown, should be very low since, with nonelectrical production, only about three wells per lease site are required and testing and venting are the only operations that would emit gases into the atmosphere.

There will be a slight impact on noise from construction projects and vehicle traffic. Well drilling, well testing and well venting produce the highest noise levels of any of the operations of geothermal development. The impacts these operations have on noise during nonelectrical development are considered less than those for electrical production because of the fewer number of wells, thus decreasing the duration and intensity of the noise caused by a few wells as opposed to the many wells with electrical production.

The noise impacts, mainly upon man and wildlife, and the variation from lease site to lease site are the same as with electrical development except they are of a lesser degree. The noise impact will be very minimal during the production stage since no powerplant is associated with nonelectrical production.

Impacts outside the potential leasing units for both air and noise will be the same as impacts inside except to a lesser degree since the effects of pollution upon air quality decrease and disperse with distance from the source. The impacts on noise will be practically nonexistent at a distance of two miles from the source.

Island Area - Potential Leasing Units 8-11

a. Electrical Production

Air

The impacts on air quality on the Island Area are very similar to those of the Wendel-Amedee Area and will not vary among units.

All leasing units are located on the same soil type which are deep alkaline soils that are susceptible to wind erosion.

The removal of vegetation through construction projects and movement of vehicles on unpaved roads contributes particulate matter to the atmosphere. Windblown dust from areas exposed by vegetation removal will also contribute particulate matter to the air.

The impacts on air quality from venting steam into the atmosphere will be the same as covered on leasing units 1-7.

Impacts outside the potential leasing units on air quality are generally the same as impacts inside and will not vary among leasing units. The impact will lessen with increase in distance from the leasing unit as gases and dust are dispersed in the atmosphere.

Herlong, located three miles to the east of the easternmost boundary of the Island Area, would be affected most. The impact is lessened by the present existence of windblown dust from dry portions of Honey Lake and areas of sparse vegetation.

Noise

The site-specific impacts on the Island Area are the same as those for the Wendel-Amedee Area.

Leasing units on the Island Area are far enough from any residential areas that the noise impact upon humans is slight. Portions of Potential Leasing Units 9 and 10 are near areas of intense waterfowl use. The initial impact would be from human activity and development and habitat loss but noise could disturb any remaining waterfowl; the extent of the impact is expected to be low if noise levels are kept within existing regulations.

The noise impact on both humans and wildlife is expected to be slightly less on the Island Area than the Wendel-Amedee Area.

b. Nonelectrical Production

Noise and Air

Impacts on air and noise will be the same as those of the Wendel-Amedee area and will not vary among leasing units.

For a more detailed analysis of impacts associated with each discrete operation, refer to TABLES 56 and 57.

B. Anticipated Impacts on Living Components

Wendel-Amedee and Island Study Area

Impacts on vegetation from each discrete operation on the potential leasing units vary insignificantly . The Wendel-Amedee and Island study areas vegetative types are comparatively similar and will be discussed under the general headings of electrical and nonelectrical development.

1. Vegetation

a. Electrical Production

Off-road vehicle travel, road and trail construction, drilling and disposal ponds associated with the exploration stage would crush or remove vegetation on approximately 38 acres of a typical 2560-area required to supply two 100-megawatt generating plants. The drilling of additional wells, constructing the power plant and transmission lines, and the construction of waste disposal ponds would remove or crush native vegetation or field crops on approximately 318 acres or 12 percent of a typical 2560-acre development area.

Removal or crushing of bitterbrush, sagebrush, Mormon tea, spiny hopsage, shadscale, and native perennial herbaceous plants will result in loss of soil protection against wind and water erosion. There will also be a degradation of habitat for several species of wildlife.

No rare or endangered plant species are known to occur within the project area. However, any surface disturbing activity has the potential for disturbing previously unidentified locations of rare and endangered species.

There would also be a loss of livestock forage associated with the development of a large electrical power generating plant (See Vegetation TABLES 29, 30, 31, and 32 and Domestic Livestock TABLES 33 and 34).

Most native perennial plants will not reestablish on a severely disturbed site to the extent that they will reproduce the original plant communities. The loss of climax plant species results in a loss of diversity and stability of the plant communities. As a result, there is a decrease in the number of different paths for the efficient flow of energy through the natural ecosystems. The subclimax annual cheatgrass type is most capable of regenerating because it represents a low seral stage of plant succession. The salt desert shrub type sites would be most difficult to rehabilitate because relatively few perennial plants are adapted to these areas of low precipitation and soils with relatively high concentrations of soluble salts. Rather, undesirable annual plants such as Russian

thistle, tansy mustard, and the toxic halogeton generally dominate such sites at a low seral stage. The climax shrubs and herbaceous and perennial plants may require very long time periods for reestablishment when removed from such areas.

Road construction, pipeline development, powerplant construction, additional well development and construction of transmission lines are considered to have the greatest adverse impact upon all types of vegetation on the proposed lease units (See TABLES 58 and 59). However, because of the relatively low percentage (12%) of the total area affected by these developments, the adverse impacts upon the vegetation are considered to be low to moderate. A higher adverse impact is assigned to the salt desert shrub type because of the difficulty of rehabilitating sites on which this type occurs. The relatively high economic value of crop plants is the primary reason for indicating high adverse impacts upon cropland resulting from the various stages of construction.

The present groundwater quality is considered very good for crop production, with all soluble salts being well within the acceptable tolerance for irrigation (See Description of the Existing Environment - Existing Groundwater Quality). It is not known what toxic salts or gaseous emissions may result from deep drilling for geothermal steam in the study areas. Excessive waste water or steam venting may result in harmful salts or gaseous substances being released in such quantities and concentrations as to have an adverse impact upon vegetation in close proximity to the wells.

The adverse impacts upon the vegetation in the buffer zone surrounding the potential lease units are considered to be generated primarily by off-road vehicle use, road construction, and construction of electrical power transmission lines. The area disturbed relative to the total of the two project areas would be small and the adverse impacts are projected to be low to moderate for all native vegetation types. There is a possibility of a high adverse impact upon irrigated crops if roads are constructed through fields. The results of several other kinds of electrical energy development and production cannot be readily assessed and are shown as "unknown" on vegetation impact matrix (TABLES 58 and 59).

The abandonment of the geothermal wells would not be either beneficial or detrimental to several of the vegetation types in terms of further damage or improvement of vegetation composition and density with two probable exceptions. Cheatgrass and saltgrass would probably regenerate on their present sites within a few years.

Removal of equipment during the closeout stage would probably have an immediate adverse impact due to crushing or pulling up established plants. The additional area involved would probably be a very low percentage of the lease unit, therefore the impact would generally be low. Damage to existing, high-value irrigated crops, where cropland may be involved, could result in a high adverse impact upon cropland vegetation.

Surface reclamation and rehabilitation would have a moderate to high positive impact upon most of the vegetation types. Rehabilitation would be most effective for grassland type and cropland. The relatively high concentration of soluble salts in the soils occupied by the salt desert shrubs makes rehabilitation of such sites very difficult.

b. Nonelectrical Production

The impacts for nonelectrical development of geothermal steam upon vegetation were considered to be quite similar through the exploratory stages to the impacts for development of electrical power. However, at the field development stage, nonelectrical developments were considered from model data to require much less steam (or hot water) than would be required for production of electrical energy. Depending upon the number of different kinds of nonelectrical facilities incorporated in one complex, the area involved could be as low as approximately 40 acres or as much as 135 acres according to data from model studies. The complexes would involve from 1.5 percent to 5.3 percent of a 2560-acre lease area depending upon the type of development.

The impact of nonelectrical geothermal development on the various vegetation types would generally be quite low except for a moderate to high impact on existing irrigated cropland. The impact upon an existing irrigated crop may be adverse. If more intensive food crop production replaced field crop production, there may be a high positive impact in terms of vegetation alone. With respect to ecological interrelationships that involve wildlife food sources and habitat, the change from field crop production to greenhouses would have an adverse impact.

2. Domestic Livestock

Wendel-Amedee and Island Study Area

Impacts on livestock from each discrete operation on the potential leasing units vary insignificantly in the Wendel-Amedee and Island study areas. Therefore impacts for both study areas will be discussed under the general headings of electrical and nonelectrical development.

a. Electrical Production

Native vegetation, covering a major portion of the area, is used for livestock grazing, the principal agricultural activity of this desert subregion. Livestock operations include cattle in the project area. These are primarily cow-calf operations.

Exploration activities, especially as they occur in areas where animals normally concentrate, such as water sources, meadows, and the saltgrass type along the lakeshore, will disturb livestock. Disturbance will result from off-road vehicle use, road and trail construction, drilling, and where stock water is used for dust abatement.

Sumps for waste-water mud collection and/or toxic materials can be hazardous to livestock and wildlife. Vehicle traffic in areas where livestock are grazing will be hazardous to livestock and rub on equipment during periods of inactivity, or when the plant ceases to operate and this could cause damage to the equipment or injury to the livestock.

Other on-site impacts from geothermal drilling, which could affect livestock if they occurred, are changes in spring and well discharge, potential for pollution of stock water, and destruction of vegetation by released geothermal fluids. The overall effect of exploration activities on livestock will probably be a reduced weight gain of the animals disturbed and may well extend to the loss of livestock if toxic materials produced are unprotected or released inadvertently into perennial or intermittent drainages and stock ponds.

The development of geothermal resources with the construction of plants for energy production may result in a total commitment of the leased area to that resource, or exclude grazing on only the actual area occupied by construction (approximately 14% of the lease area). Leased areas that breech pasture fences will interfere with livestock movements and thus use of the surrounding area. However, current estimates of lands dedicated to this use appear to be minimal and do not impose a significant overall negative impact.

Impacts outside the potential leasing units include potential damage to, or destruction of, stock-water sources near the leased area due to the predicted decreased recharge to shallow water tables. Furthermore, the production and disposal of geothermal fluids may adversely affect shallow groundwater tables and surface water resulting in a loss of some forage and water sources for livestock. TABLE 49 gives an insight into economic impacts upon the livestock industry associated with the potential loss of livestock grazing on the potential lease units. TABEL 60 is an assessment of the potential degree of impacts associated with discrete operations involved with electrical development.

Economic Impacts Upon Livestock Industry.*

1. Total livestock forage demands in Lassen County = 763,884 AUMs (1)

2. Income derived from livestock in Lassen County = $5,659,101.00

3. Estimated livestock income per AUM = $7.41

4. Annual loss of income to livestock industry as a result of electrical power development.*

TABLE 49

Lease Unit No.	AUMs Forage	Livestock Income per AUM (1)	Excluding All Livestock Grazing on Leasing Units	Excluding (2) Livestock grazing on 14% of Lease Unit Area
1	60	$7.41	$ 445	$ 62
2	74	7.41	548	77
3	42	7.41	311	44
4	19	7.41	141	20
5	106	7.41	785	110
6	94	7.41	697	98
7	99	7.41	734	103
8	78	7.41	578	81
9	70	7.41	519	73
10	66	7.41	489	68
11	56	7.41	415	58

Totals for all lease units = $5,662 $794

(1) Approximately 800 pounds of air dry forage per month.

(2) Approximately 14 percent of a typical 2,560 acre lease area is utilized for all types of development and construction.

5. Ratio of livestock income to total personal income for Lassen County = 10.4 percent.

*Source: An Economic Profile, Bureau of Land Management, Susanville District by Jean Watanabe. 1975.

b. Nonelectrical Production

The development of nonelectrical uses of geothermal steam would result in some adverse impacts upon livestock grazing. Road construction, drill site development, and intermediate well development during the exploration and field development stages would disturb the normal feeding, drinking and resting activities with some probable reduction in rate of gain in weight. Construction of food processing plants, greenhouses, facilities for single protein production, or other nonelectrical energy facilities would also temporarily disturb the normal activities of livestock. For a more detailed analysis of impacts associated with discrete operations associated with nonelectrical development, refer to TABLE 61.

There would be some loss of forage production due to the land area being utilized by roads, buildings, ponds, parking areas and other industrial facilities. TABLE 50 is an assessment of the potential degree of impacts associated with discrete operations involved with nonelectrical development.

TABLE 50

ANNUAL LOSS OF INCOME TO LIVESTOCK INDUSTRY AS A RESULT OF NONELECTRICAL COMPLEX DEVELOPMENT.*

Lease Unit No.	AUMs Forage	(1)Excluding Livestock Grazing on 1.5% of Lease Unit Area	(1)Excluding Livestock Grazing on 5.3 % of Lease Unit Area
1	60	$ 6.67	$ 23,56
2	74	8.23	29.06
3	42	4.67	16.49
4	19	2.11	7.46
5	106	11.78	41.63
6	94	10.45	36.92
7	99	11.00	38.88
8	78	8.67	30.63
9	70	7.78	27.49
10	66	7.34	25.92
11	56	6.22	21.99

Totals of All Lease Units = $84.92 $300.03

(1) Value of Livestock per AUM = Approximately $7.41

The impacts of nonelectrical geothermal development upon the livestock industry would be minimal.

*Source: An Economic Profile, Bureau of Land Management, Susanville District by Jean Watanabe. 1975.

3. Wildlife

Imposing an industrial-power and/or agri-industrial complex on an area which has been historically free of human development and prolonged disturbance will result in immediate and long-term impacts on wildlife.

Important problem areas to be considered are: increased human intrusion into sensitive areas as a result of improved public access; vegetative disruption and modification; toxification, elimination and displacement of valuable ground water and surface water resources; and increased levels of noise and air pollution. Beneficial impacts include: the utilization of potential high quality excess geothermal fluids to supplement intermittent water resources, and the modification of native vegetative communities resulting from revegetation operations.

General Impacts

The following discussions address general impacts associated with discrete operations throughout the Wendel-Amedee and Island study areas. Following these is a discussion of impacts expected on each potential leasing unit from both electrical and nonelectrical development.

Mule Deer and Pronghorn Antelope

Limited mule deer and pronghorn antelope range exist in the Honey Lake Geothermal Resource area. Adverse impacts will result primarily from increased human intrusion into the canyon bottoms and in Spencer Basin. This increase will result from improved road and trail construction. Spencer Basin is limited in terms of size (4 square miles) and in terms of vegetative and natural cover. Spencer Basin is east of the Wendel-Amedee study area, but its nearness to possible human intrusion requires that it be mentioned. Any prolonged human disturbance in or near this area will cause the abandonment of the area by antelope and deer.

The availability of water constitutes a limiting factor in the Wendel-Amedee Area. Consequently any practice which may result in the toxification, elimination and/or displacement of ground water supplies, springs or seeps will result in adverse impacts on deer and antelope.

The basin area and the adjacent canyons constitute a "critical area", for if either is altered or destroyed, it would result in an immediate and long-term decline in deer and antelope numbers in this area.

Birds of Prey

The Amedee Mountains contain the highest density of nesting raptors in the District known to date. Should this population be subjected to the impacts of geothermal exploration, development and production, it will decline. This decline will result from nest disturbance and from the elimination or reduction of prey species due to vegetative disruption.

Future road construction in the Wendel-Amedee area will permit greater access into otherwise inaccessable areas by work parties as well as the general public. Human intrusion during the early stages of the nesting cycle by persons not knowledgeable in terms of raptor sensitivity can cause nest desertion and lose of young. The combined effects of increased human intrusion, high levels of noise and construction will jeopardize the future of many sensitive raptor birds by preventing or limiting the potential for maximum production of young. Potential effects of interference vary greatly depending upon the species, the idiosyncrasies of individuals, the previous experience of the birds with man and the level of acceptability of nest sites. The failure of parent birds to return to eggs or young after intereference is both serious and unpredictable. In addition to nest disertion, any of the following problems can be encountered when a nest is visited: Accidental breakage of eggs, the trampling of young and/or the forceable expultion of young from the nest due to the disorderly departure of the parents. Newly hatched birds may suffer from cooling or overheating and be subjected to periods of starvation and increased predation due to the absence of adult birds from the nest. Vandalism and pilferage also increases with greater public awareness of known nest sites.

The direct utilization of the Wendel-Amedee area by industrial concerns will result in the reduction or elimination of prey from important raptor hunting grounds. The vegetative disruption of some 7,042 acres of prime raptor hunting grounds by road construction, well or drill site preparation, disposal ponds, pipelines, powerplant construction and transmission lines will cause the displacement of prey species important in the diet of birds of prey. Increased vehicle use in this area will result in an increase in traffic mortalities, both to raptors and to important prey species. Reproductive success by raptors is governed greatly by the availability of prey species. The problem of prey availability will be compounded by low numbers associated with cyclic declines in the rodent and rabbit populations.

Further impact on raptors will result from shootings and electrocutions in conjunction with the increase in transmission line construction.

Threatened and Endangered Species

The Federal Endangered Species Act of 1973 extends federal protection to the Southern Bald Eagle, a regular winter visitor in the Honey Lake Area. It is the BLM's policy to protect any endangered species from any action associated with BLM-related activities which may threaten or

impair the species' status or habitat requirements. Based on existing information, no impacts are anticipated to the Southern Bald Eagle.

Waterfowl

Honey Lake provides valuable waterfowl and shorebird habitat for both nesting and migratory species. Geothermal development can have both negative and positive implications, depending on the quality of the excess geothermal fluids and the proximity in which development occurs.

High quality geothermal fluids may be utilized to enhance existing waterfowl habitat and to improve semi-permanent water sources. Adversely, should these geothermal fluids prove to be toxic in composition and should development occur in close proximity to the lake, the possibility for contamination is increased. Production testing, blowouts and seepage from evaporation reservoirs can result in serious consequences. If contamination results, the ability of the lake to support the vegetation and animal life on which waterfowl feed will be hindered.

Industrial wastes, whether from agri-industrial or energy-related operations, may change the character of the waterway until it is no longer of use to waterfowl. Development of off-shore sites in Honey Lake can also lead to the reduction in waterfowl food and shelter. Thermal pollution, resulting from the cooling of geothermal fluids, is also harmful. Waterfowl may be subjected to detrimental effects of containinated evaporation reservoirs or drilling sumps if not properly contained.

Two areas of potential impact exist. The two coves located on the southwest corner of the "Island" are utilized by migrating and wintering waterfowl. The northwestern shoreline, between the Amedee Hot Springs and the Susan River inlet, is a waterfowl production site for several species of ducks.

Nongame Birds

Any practice which will destroy or alter the composition of the vegetational covering on a site will result in the disruption and/or the curtailment of activities associated with endemic songbirds. Road construction, off-road vehicle use, drillsite preparation, production testing, powerplant construction, pipeline and powerline development all result in vegetational destruction in varying degrees. Songbirds are very susceptible to impacts as a result of their close association with vegetational or natural communities. Many species are both physically and behaviorally adapted to specific habitat types. Any change which

affects the bird's ability to gather food or hinders its nesting activities will result in the bird's abandonment of the site. If leasing occurs, some acres will be susceptible to modification.

Revegetation is not always possible if erosion or degradation of the soil has occurred. Furthermore, revegetation will not always result in the species' composition and density similar to that which existed prior to development. Last, revegetation, even if successful, cannot make up for the loss of avian production during recovery or power production periods.

Upland Game

The status of upland game birds, i.e. Chukar Partridge and California Quail, in the Wendel-Amedee study area is dependent upon the seasonal availability of free water. If geothermal development occurs, poisoning from toxic geothermal fluids and the disruption and relocation of existing springs and seeps can occur.

The exact chemical composition of the potential geothermal fluid is unknown but it appears likely that such fluids can be detrimental to life. Toxic substances such as boron, arsenic, fluoride and zinc may be present in minute but nonetheless significant quantities. Evaporation ponds or reservoirs and reserve pits, if not properly contained, can become a source of contaminated fluids. The physical structure of the reservoir (Steepness of the sides and the depth) can also be a detriment. Young birds and mammals alike can drown as a result of being pushed in under crowded circumstances.

During production testing and in the event of an accidental blowout, water, steam and particulate matter are vented to the atmosphere and onto the surrounding landscape. This will serve to further the likelihood of poisoning caused from the consumption of contaminated water, forage and/or gravel. Drilling operations require substantial quantities of water during operations (500-1000 barrels/day/well). This water can come from surface water wells or be trucked to the site. When this figure is magnified by the demand of additional wells (17-20 per power-plant) the impact on local water reservoirs can be great. Springs may dry up or reappear in different places. The impact on local upland game populations will be great if this situation arises.

The impact created by greater public access into prime habitat areas cannot be accurately ascertained at the present time.

Small Mammals

As coyotes and badgers are very opportunistic, they are not expected to suffer as a result of geothermal activities.

Rabbits are generally very tolerable of human activity. Increased traffic related mortality, however, is expected due to the increase in vehicle use and the addition of new access roads.

All forms of rodents will be impacted as a result of habitat destruction and/or modification. Densities and species composition may be altered.

Potential Leasing Units 1-11 - Wendel-Amedee and Island Study Areas

a. Electrical Development

Potential Lease Site 1. Lease Application Number 1 contains two environmental units, Sagebrush and escarpment habitat. The leasing of this 760-acre site for geothermal development and production will lead to local declines in Burrowing Owl numbers. Two pairs of Burrowing Owls nest in the SW¼ Sec. 12, T.29N., R.15E. No reproductive data are available.

The chief limiting factor controlling Burrowing Owl numbers is burrow availability. As this raptor is highly dependent upon medium sized burrowing mammals for nesting burrows, any activity which will result in the direct displacement or elimination of those mammals will have adverse influence on future reproduction and inhabitation. Additional impacts associated with geothermal development on Burrowing Owls are: Increased traffic related mortalities, shooting incidents and nest destruction.

Burrowing Owls are considered to be declining by the National Audubon Society. Impacts on Prairie Falcons, Golden Eagles, Marsh Hawks and Red-tailed Hawks should also be expected as a result of the elimination of valuable hunting range.

Potential Lease Site 2. If geothermal activities are permitted on Lease Tract Number 2, four species of raptors will suffer local population reductions. The escarpment habitat on this site actively supports a pair of Prairie Falcons, a pair of Golden Eagles, a pair of Great Horned Owls and two pairs of American Kestrels. All of the above-mentioned species fledged young in 1976. Prairie Falcons and Golden Eagles fledged two young each.

Extended periods of human activity associated with exploration and development on this site will result in the desertion of the eggs, nestlings and/or territory by the adult birds. The annual loss of production can be magnified in terms of lost breeding stock for future

generations to come. In addition to the loss of potential reproduction, direct mortalities to adult and juvenile raptors will increase. Electrocutions, vehicle-related mortalities and shootings will rise. Public interference will increase the likelihood of nest-related accidents and desertion. The most serious impact for raptors on this site is the potential loss of seclusion and solitude historically enjoyed through the years.

The reevaluation of the Wendel-Amedee area as a proposed Bighorn Sheep reintroduction site will occur if leasing is approved. An alternative location may well be in order as Bighorns are known to tolerate only limited amounts of human activity. Wendel Canyon (NE¼: Sec. 22, T.29N., R.16E.) is the proposed release site for the herd. This area would be less than one mile from geothermal development should it be approved. The site is on the oppisite side of a north trending ridge and should protect the sheep from any immediate contact with geothermal development.

Potential Lease Site 3. The adjacency of Lease Number 3 to a Golden Eagle and Prairie Falcon eyrie is important in terms of the site's ability to produce a source of prey for nesting raptors. The availability of prey is reflected in the reproductive success of many species of raptors. The quantity and quality of hunting territory in addition to nest site availability determines, to a great extent, the acceptance and utilization of a particular area by raptors in general.

Golden Eagles rely heavily on California Black-tailed Hares, Nuttall's Cottontail and Chukar Partridge in this area. All of the above prey has been surveyed in the bench lands. Prairie Falcons prey upon the following species: Western Meadowlarks, Brewer's Blackbirds, Sage Sparrows, Mourning Doves and Rock Wrens. All of these species occur in escarpment habitat.

Should Lease Site Number 3 be leased for geothermal development, some 640 acres of escarpment habitat will be susceptible to vegetative disruption or modification. A change in vegetative cover will result in the reduction or elimination of many of those species of prey important in the diet of Prairie Falcons and Golden Eagles.

Potential Lease Site 4. The Honey Lake Wildlife Area is an important link in the California State Refuge System. Provision has been made to control water levels, in order to permit the maximum production of waterfowl food and cover, to provide sanctuary for rare forms of wildlife and to help meet the demand for increase public hunting.

The area is within a major migration path for migratory waterfowl in the Pacific Flyway. Large flocks of geese, ducks and shorebirds converge on this area during peak migration periods in the spring and fall. Waterfowl needs consist of nesting, feeding and resting habitat.

Serious loss of waterfowl habitat will result should potential Lease Site 4 be developed. The effects of superimposing an industrial complex in such close proximity to a known waterfowl and shorebird production area may alter the present temperature, quality and quantity of water. A discharge of toxic geothermal fluids could alter food chains and cause direct mortality.

Potential Lease Site 5. If development were to occur on this potential lease site, a maximum of 14 percent of 1,205 acres of sagebrush and greasewood habitat would become susceptible to vegetative modification or destruction. Golden Eagles and Red-tailed Hawks have been observed to hunt this given area. The value of hunting territory as grounds for the selection of a nesting site cannot be underestimated. Reproductive success is directly related to the availability of prey.

Golden Eagles feed heavily on Yellow-bellied Marmots, California Black-tailed Hares and Nuttal's Cottontails which inhabit the sagebrush and greasewood environmental units. A review of a Red-tailed Hawk's dietary preferences shows that Red-tails prey heavily upon ground squirrels, chipmunks, rabbits and mice. The sagebrush and escarpment habitat provides Antelope Ground Squirrels, Yellow-bellied Marmots, Least Chipmunks, five species of mice and rats in addition to California Black-tailed Hares and Nuttall's Cottontails.

No estimate of raptor-use days are available for this site.

The development of an industrial complex on this lease site would greatly reduce the value of this habitat for supporting local raptor populations.

Potential Lease Site 6. Four species of raptors have been observed to utilize potential Lease Site Number 6 while in pursuit of prey. Golden Eagles, Red-tailed Hawks, Marsh Hawks and American Kestrels have been identified on the site. No raptor-use days are available to date. If approved for leasing, 1,322 acres of sagebrush and greasewood habitat would become available for geothermal development and production. Any activity which will result in the destruction and/or modification of vegetative cover will degrade the effectiveness of the site to provide quarry for hunting raptors. Hunting territory is extremely important in the selection of nesting sites. The high density of raptors in the Amedee Mountains can be conceived as a reflection in the availability of prey species.

Potential Lease Site 7. Prairie Falcons are intolerable of nest site disturbance, especially during the early phase of the nesting cycle. Nest and territorial desertion will result if geothermal exploration and development occur on potential lease site 7.

Some 1,600 acres of escarpment, sagebrush and greasewood exist in this lease site. The escarpment actively supports a pair of Prairie Falcons, a pair of Long-eared Owls and a pair of Burrowing Owls. The greasewood unit contains an active pair of Red-tailed Hawks. Production data is incomplete for all of the species mentioned.

Development near active nest sites may cause the abandonment of the site for a period of years or indefinitely. The potential production of young for many years will be lost.

Waterfowl production may be reduced should industrial development be allowed on Lease Site Number 7. The eastern shoreline of Honey Lake between the Amedee Hot Springs and the Wildlife Management Area is recognized by California Department of Fish and Game as a waterfowl production area for several species of ducks. Water temperature and quality may be a detriment to food chains and vegetative cover.

Potential Lease Site 8. Lease Application Number 8 contains some 1,254 acres of receding shoreline and greasewood habitat. This particular site is of moderate value to migrating waterfowl and shorebirds. Should the quality of geothermal fluids prove to be of high standard, excess discharge should prove beneficial to waterfowl habitat.

Potential Lease Site 9. Moderate to heavy seasonal use occurs in the two intermittent coves located on Honey Lake's southwestern corner. Valuable waterfowl and shorebird habitat occurs in lease site 9 where it touches the receding shoreline of Honey Lake. The two coves are used as resting and staging areas by migrant waterfowl and shorebirds. During the spring of 1976, 300 Whistling Swans, numerous ducks and shorebirds were observed here. During the winter months of January and February, Bald Eagles have been observed in the area. High quality excess geothermal fluids could prove beneficial.

No wildlife values have been observed on the remaining 1,000 acres of mixed sagebrush habitat.

Potential Lease Site 10. Waterfowl and shorebird activity in Honey Lake's southwestern corner is governed by the availability of seasonal water. During peak migration periods, large numbers of swans, ducks and shorebirds occupy the area surrounding the mouth of Long Valley Creek.

Any activity which would serve to alter the quantity, quality and temperature of this intermittent cove could have a significant impact on staging and nesting waterfowl. Should the excess geothermal fluids prove to be of acceptable quality, beneficial results could be obtained by preserving semi-permanent water sources.

Potential Lease Site 11. Lease Application Number 11 contains 803 acres of receding shoreline, greasewood and sagebrush habitat. The area is characterized by moderately sized dunes and two alkali sinks.

No wildlife values were identified on this site.

b. Nonelectrical Development

Geothermal energy development for nonelectrical purposes will be damaging to wildlife. The degree of surface disturbance will be less as compared to electrical power production. The net effect of increasing human activity levels, noise and accessibility will be detrimental, especially to sensitive nesting raptors.

Geothermal development near active raptor nesting sites will result in nest desertion, territorial abandonment and the loss of potential breeding stock for future generations to come.

The development of an agri-industrial complex in association with access roads, drill sites, pipelines and injection wells will cause the disruptions in hunting behavior and potential changes in prey number and composition.

Other notable impacts include the reassessment of a proposal to reintroduce Bighorn Sheep into the Amedee Mountains by CDFG and a potential change in the quantity, quality and temperature of Honey Lake as related to waterfowl and shorebird habitat.

Impacts for nonelectrical development closely parallel those for electrical development.

For a more detailed analysis of impacts related to discrete operations associated with electrical and nonelectrical development, refer to TABLES 62 and 63.

C. Anticipated Impacts on Human Interest Components

1. Aesthetics

Discrete Operations (Electrical and Nonelectrical)

Preliminary Exploration Stage

Various impacts on aesthetic values would result from preliminary exploration. The temporary presence of man, his aircraft, vehicles, and small, truck-mounted drill rigs, with the associated dust and noise from their operation, would be obvious in the landscape. From these temporary presences would be impacts caused by the surface disturbances discussed below.

New trails would introduce new elements of line and alter the texture and color of the landscape by removing vegetation and compacting or displacing surface materials. Trails are highly visible when they cross slopes or when observed from a superior elevation and would continue to be visible for years after they are no longer used. A secondary impact would be the probability of continued use of these trails by recreational ORV's to gain access to previously untraveled areas and to create additional new trails.

Drill sites alter the texture and color of the existing landscape due to vegetation removal and displacement of surface materials. Other surface disturbances such as seismometer placement and electrode placement may also alter the overall landscape but to a very minimal degree.

Throughout preliminary exploration, waste materials would be generated in the forms of drilling mud, drill cuttings and solid waste. If disposed of at the point of generation, these wastes would alter the color of the existing landscape.

During preliminary exploration, impacts on aesthetics would be identical for electrical and nonelectrical production.

Although limited in extent, the cumulative impacts of preliminary exploration on aesthetics would be moderate on Class II lands and low on Class III and IV lands.

Exploratory Drilling Stage

Impacts on aesthetic values from exploratory drilling would include the temporary presence of workers, drill rigs, earth moving equipment and service vehicles with the associated dust, noise and night lighting from their operation. From these temporary presences would be impacts in the forms of surface disturbance, excavation and waste materials.

New dirt roads would introduce new elements of line and color in the linear form of the roads and the introduction of gravel in some areas to stabilize the existing surface. Color and texture would be altered by the removal of vegetation and the compaction and displacement of surface materials. Roads would be visible on flat lands from approximately ¼ mile away. Where either the roads or the observer are in an elevated position, the roads would be visible to the unaided eye for up to 12 miles. A secondary impact would be the probability of use of these roads by ORV's to gain access to previously untravled areas with a high likelihood of the creation of additional new trails and further impacts on the area.

Development of drill sites would alter the color and texture of the landscape. Road grading and ditching would alter the form, line, color and texture. Drilling platforms and mud pits would alter the form, color and texture. Spent drilling mud, drill cuttings and solid waste generated during exploratory drilling would be of uncharacteristic color and texture in the landscape.

During exploratory drilling, impacts on aesthetics would be identical for electrical and nonelectrical production.

The cumulative impacts of exploratory drilling would be high on Class II lands, moderate on Class III land and low on Class IV lands.

Field Development Stage

Impacts on aesthetic values from field development would be similar to those of exploratory drilling, but greater in magnitude and intensity.

Generally, all types of surface disturbance will alter the form, line, color and texture of the environment and may be visible to an observer from ¼ mile to 12 miles, depending on the elevation of the viewer in relation to the object being viewed and its elevation as well. The presence of workers, drill rigs, earth-moving equipment, construction equipment and service vehicles with the associated dust, noise and night lighting from their operation would be obvious. A short-term impact would be the noise, steam, waste water and odors from production testing. Long-term impacts in the forms of surface disturbance, excavation, waste materials, pipelines, transmission lines, fences, roads and the generating plant site with all associated structures would result from field development.

Impacts associated with the development of drill sites would be essentially identical to those already discussed. The surface disturbance associated with pipeline transmission routes would have the same general impacts as new dirt roads because of their linear form, excavation and service roads.

The surface disturbance at the generating plant site would alter the form, line, color and texture of the landscape through the removal of vegetation and compaction and displacement of surface materials over a large area. Visual range on flat lands would be about one mile and at least 12 miles when either the site or the viewer was at an elevated position.

Surface disturbance from fencing installation would have the same impacts as new trails because vehicle access would be necessary for installation and the fence would be of linear form. Scarification would alter the texture of the land in the areas where it occurs.

Pipeline supports and transmission tower foundations would introduce new line and color in the landscape due to the linear routes, the excavation and the footings themselves. Building foundation construction would introduce new form, color and texture in the landscape.

Evaporation pond and berm construction would also introduce new form, line, color and texture. Excavation associated with rehabilitation activities on portions of the project which have been closed out would alter the form and color of the landscape.

The generating plant, cooling towers and associated buildings would introduce new form, line, color and texture. Pipelines and well heads would also introduce new form, line, color and texture due to their linear alignment, consistent and repetitive tubelike form and unnatural coloration and smoothness. Because of their scale, the visual range of these structures would be limited only by the capabilities of the human eye.

Transmission poles, conductors and insulators would introduce new form, line, color and texture. The visual range would vary with the relationship of the transmission towers to the landscape, as little as 2 miles when closely backdropped or 9 miles when skylined.

Fencing would also introduce new form, line and color into the existing landscape with the visual range dependent on the construction materials used.

Field development for nonelectrical production would have less impact on aesthetics than that for electrical production due largely to the smaller land acreage (1/3) needed for development and the smaller scale structures required, such as for pipelines and plant construction.

The cumulative impacts of field development can be considered high on Class II and III lands, and moderate on Class IV lands.

<u>Production Stage</u>

Impacts on aesthetic values from production and operation include the presence of workers, trails, dirt and surfaced roads, pipelines,

well heads, transmission lines, drill rigs and sites, earth-moving equipment, service vehicles, fencing, the generating plant and associated structures. The dust, noise, odor, steam clouds and waste materials associated with these impacts would be present. New and continuing impacts resulting from production would be surface disturbance, excavation, production of waste materials, and the associated dust, noise, steam, odor and night lighting.

Impacts from surface disturbance would essentially be identical to those previously discussed for new trails, dirt and surfaced roads, drill sites, pipeline routes and scarification.

Impacts from excavation would be identical to those previously discussed for grading and ditching of roads, development of mud pits and the construction of pipeline supports and rehabilitation activities.

Dust, noise, steam, odors and night lighting would be present throughout production and operation and until closeout occurs.

Impacts on aesthetics from nonelectrical production would be less than that for electrical production as fewer acres are required for development. Facilities would be constructed on a much smaller scale, thus the form and line of these structures would have less impact when viewed from nearby travel routes.

The cumulative impacts of production and operation can be considered high on Class II, III and IV lands.

Closeout Stage

Impacts on aesthetic values would result from the temporary presence of men and their construction and demolition equipment, earth moving, and the associated dust and noise. Lasting impacts would result from closeout in the forms of surface disturbance, excavation activities and waste materials and would be similar to those previously discussed.

Impacts on aesthetics would be the same during closeout for electrical and nonelectrical production.

The cumulative impacts of closeout can be considered high on Class II lands and low on Class III and IV lands.

2. Recreation

Discrete Operations (Electrical and Nonelectrical)

Preliminary Exploration Stage

The primary impact on preliminary exploration upon recreational activity would be the surface disturbance. Recreationists in search of natural surroundings (wilderness values) would find any surface disturbance offensive.

Roads and trails built during exploration might be used by ORV enthusiasts and as part of motorcycle race courses. These roads and trails might also be beneficial to those seeking easier access for rockhounding or hunting. However, this increased access might put a strain on the resources which they seek. For those seeking wilderness values, viewing botanic scenery or other natural beauty, the naturalness of the environment is a positive factor and roads would be an impairment to their enjoyment of the area. Roads and trails could eliminate future consideration of an area for wilderness designation.

Until such time as the wilderness review is completed on the identified roadless area, the area must be under interim management to protect potential wilderness values. No action will be taken within the area that would impair the suitability of the area for preservation as wilderness.

According to a solicitor's opinion sent to the Director of BLM in a memo dated May 23, 1977, "study areas should be managed so as to preserve their wilderness characteristics but all current activities can continue subject to controls in order to protect wilderness characteristics... If proposed or current activities are discretionary, they should be conditioned in order to preserve the wilderness characteristics or the potential for future wilderness area designation. Thus, if a particular action is reversible, such as a road which can be scarified or livestock improvements such as fences which can be removed, it would be consistent with interim management for inventoried roadless areas. Difficulties arise only when actions are proposed which would destroy the potential of the area for ultimate wilderness designation."

Motorcycle racing and ORV pleasure riding would not be limited by exploration activities. Roads constructed for exploration activities might be used for motorcycle races or ORV pleasure riding, thereby increasing the number of routes available for these activities. However, with these new roads, access may be possible to country heretofore lightly impacted by ORV's.

During preliminary exploration, impacts on recreation would be identical for electrical and nonelectrical production.

Exploratory Drilling Stage

The impact of the exploratory drilling on recreational activities would be much the same as the impact during preliminary exploration. However, some impacts would be greater due to construction of more roads and larger areas of surface disturbance for drill pads.

Field Development Stage

Development of the geothermal resource would impair all recreational activities in the immediate vicinity of the site, with the overall effect dependent upon the physical size of the development and the area it covers. Extensive development could prevent utilization of some portions of motorcycle race routes. ORV pleasure riding would similarly be affected. Camping would essentially be eliminated in the actual areas of development. Recreation activities which depend on other resources would be directly affected. For example, removal of vegetation would hinder botanic and wildlife sightseeing as well as hunting.

Field development for nonelectrical production would have less impact on recreation than that for electrical production due largely to the smaller acreage required for development (approximately 100 as compared to over 300).

Production Stage

Development of the geothermal resource and its attendant facilities would present physical barriers to vehicle travel. The presence of a generating plant would remove the sense of remote open space enjoyed by many ORV pleasure riders. Often this ORV pleasure riding is in connection with other recreation activities, thus riding would be affected as those activities are affected.

Plant operation with accompanying transmission lines, pipelines, paved roads, noise, etc., would have a serious impact on the natural atmosphere of the surrounding area. Wilderness values would be eliminated in the area where the generating plant and related structures would be noticeable.

Nonelectrical production would require approximately one-third of the acreage as that for electrical production, thus the total impact on recreation activities that utilize the land surface would be less. Structures and their utilization during operation would be on a smaller scale, however, impacts on the natural atmosphere or primitive values would still be evident.

Wendel-Amedee and Island Areas
(Potential Leasing Units 1-11)

Following is a summary by potential leasing unit of the Visual Resource Management (VRM) classes and recreation activities within each unit. (The average impacts are based on the stages with the greatest impacts - field development and production - electrical.) For more specific impacts related to each resource in a potential leasing unit, refer to TABLES 64 and 65.

Unit 1. VRM Classes II and III were identified. Recreational activities include motorcycle events, ORV pleasure riding and hunting.

Average impact ratings for Unit 1 were determined to be moderate-high for aesthetics and low-moderate for recreation.

Unit 2. VRM Classes II and III were identified. Recreational activities include motorcycle events, ORV pleasure riding, and hunting. A portion of the roadless study area falls within Unit 2.

Average impact ratings for Unit 2 were determined to be moderate-high for aesthetics and moderate for recreation.

Unit 3. VRM Classes II and III were identified. Recreational activity include is primarily hunting. A portion of the roadless study area falls within Unit 3.

Average impact ratings for Unit 3 were determined to be moderate-high for aesthetics and moderate-high for recreation.

Unit 4. VRM Class III was identified. Recreational activities include motorcycle events and ORV pleasure riding.

Average impact ratings for Unit 4 were determined to be moderate for aesthetics and low for recreation.

Unit 5. VRM Classes III and IV were identified. Recreational activities include motorcycle events, ORV pleasure riding, hunting, undeveloped camping, geologic collecting and sightseeing.

Average impact ratings for Unit 5 were determined to be moderate for aesthetics and low for recreation.

Unit 6. VRM Class III was identified. Recreational activities include motorcycle events, ORV pleasure riding and hunting. A portion of the roadless study area falls within Unit 6.

Average impact ratings for Unit 6 were determined to be moderate for aesthetics and low-moderate for recreation.

Unit 7. VRM Classes II and III were identified. Recreational activities include motorcycle events, ORV pleasure riding, hunting and archaeological sightseeing. A portion of the roadless study area falls within Unit 7.

Average impact ratings for Unit 7 were determined to be moderate-high for aesthetics and moderate for recreation.

Units 8, 9, 10. VRM Classes II and IV were identified. Recreational activity is primarily artifact hunting.

Average impact ratings for Units 8, 9, and 10 were determined to be moderate-high for aesthetics and low for recreational.

Unit 11. VRM Class IV was identified. Recreational activity is primarily artifact hunting.

Average impact ratings for Unit 11 were determined to be moderate for aesthetics and low for recreation. For more detailed analysis of impacts associated with each discrete operation, refer to TABLES 64 and 65.

Cumulative Impacts

Wendel-Amedee

Within the Wendel-Amedee portion of the study area, VRM Classes II, III and IV were identified. Recreational activities include motorcycle events, ORV pleasure riding, hunting, undeveloped camping, archaeological sightseeing, geologic collecting and sightseeing. A portion of the roadless study area is in the Wendel-Amedee Area.

Average impact ratings for Wendel-Amedee were determined to be moderate-high for aesthetics and low-moderate for recreation.

The Island

Within the Island portion of the study area, VRM Classes II and IV were identified. Recreational activity is primarily artifact hunting.

Average impact ratings for the Island were determined to be moderate-high for aesthetics and low for recreation.

3. Archaeological and Historical Resources

Wendel-Amedee Study Area

a. Archaeological Resources

In assessing potential impacts on archaeological resources at the sequential stages of geothermal exploration and development, it must be borne in mind that any impacts on these resources, once effected, are irreversible; there is no way, once a prehistoric site has been completely or partially destroyed, to reconstitute its component parts, reintegrate their context, or restore the deteriorated information content. Also, the various types or categories of sites are not equally

sensitive to impacts at the various stages of development, and the relative sensitivity of any particular type of site is not simply a function of its 'significance' or information content. For example, light, diffuse surface scatters of stone chippage have, intrinsically, a much lower information content than large, dense, deep occupation sites. Because, however, their patterns are more ephemeral, and because they are totally exposed on the surface of the ground, they are less able to absorb the impacts of such relatively mildly surface-disturbing activities as off-road vehicle exploration. Conversely, as ground-disturbing activities grow more severe, the burden of impacts on the total cultural resource base shifts to the larger, more complex, ostensibly more 'significant' sites and districts.

TABLES 66 and 67 describe impacts for each potential leasing unit associated with each discrete operation involved in electrical and nonelectrical development.

The following list addresses the anticipated impacts of each stage of geothermal development upon the defined site types.

Defined site categories are as follows:

1. Villages
2. Temporary or seasonal camps
3. Lithic scatters
4. Quarries
5. Isolated milling stations
6. Caves/rock shelters
7. Piled stone constructions
8. Petroglyphs

Discrete Operations

(1) Electrical Development

Preliminary Exploration Stage

Airborne. No impact.

Off-Road (foot). Chief impacts will consist of artifact collection by survey personnel, especially where recognizable artifacts remain on the surface of Site Categories 1-6. Defacement or alteration of Categories 7 and 8 is not anticipated to be great.

Off-Road (vehicle). Compounding the impact of the presence of survey personnel, vehicluar travel will alter the surface configuration of Site Categories 1-5, disturbing contexts and perhaps fracturing cultural materials, and in the case of Categories 3 and 4, by altering the distributional integrity of surface scatters, might completely obliterate their fragile information content. The impacts on Categories 6-8 are not anticipated to increase through moderate vehicular traffic.

Exploratory Drilling Stage

Road Construction and Use. The unmitigated surface and subsurface disturbance wrought by road construction might adversely impact all site types, save Category 6, by altering contexts and fragmenting cultural materials. Indirectly, by providing improved access to otherwise inaccessible site vicinities, this stage might impact all site categories by increasing their availability to collectors and vandals.

Drill Site Development. Drill pad clearance of 1-2 acres in extent could, depending upon location, totally obliterate all categories of sites within the project area. An associated reserve pit 6-8 feet in depth would likewise result in total destruction of all cultural contexts within the scope of the development.

Drilling. Subsurface drilling would destroy both surface and subsurface contexts of all categories of sites. Impacts on the total cultural resource base would be most severe where drilling penetrated sites with vertical deposits (as in Categories 1, 2 and 6).

Well Testing. Should blowouts occur, with subsequent deposition of water and mud on the surrounding landscape, off-site impacts could consist of flooding, erosion, or burial of adjacent cultural resources. Such impacts might be particularly severe in the case of site Categories 1-5. Accompanying ground tremors or landslides could result in the collapse or burial of Categories 6-8 as well.

Field Development Stage

Intensive Well Development. This stage would compound and accelerate the impacts of exploratory drilling by whatever factor the intensity of development is increased. Particularly in the case of very large sites (as Category 1 sites), where exploratory drilling might have only a partial impact on about 2 surface acres, extremely intense development might result in total site obliteration.

Well Venting. Archaeological impacts of well venting have not been tested and at present cannot be precisely defined, much less quantified. The release of significant quantities of noncondensible gases and vapors, however, might be expected to affect the deterioration rates of organic cultural materials as well as contributing to the patination or decomposition of petroglyph surfaces.

Waste Disposal. The construction of waste impoundments might, depending upon location, adversely impact or totally destroy sites of all categories. Any contribution to erosion would particularly impact Site Categories 1-5 by altering surface distribution and displacing vertical deposits.

Pipeline Development. Pipeline placement to transmit steam or hot water to power production sites would impact all categories of sites through the required support and construction measures. Realistically, because of their physiographic locations, cave sites (Category 7) are not likely to receive major impacts, but Categories 1-5, with sensitive patterns of surface and subsurface distributions of cultural material, would be impacted through the construction of access roads and the movement of construction equipment.

Powerplant Construction. The placement of a single 100-megawatt powerplant would result, aside from the impacts attendant upon providing access roads, moving equipment, and actual construction, in the total destruction of cultural resources over a 5-acre tract. This would be sufficient to obliterate totally any site within the study area save the largest villages of Category 1. Two such plants could be absorbed only by one archaeological site within the study area and that, by virtue of its complexity, depth, and preeminent research potential, would suffer the deterioration of a significant portion (about 10%) of the region's most valuable cultural resource.

Production Stage

Additional Well Development. If occurring on archaeological sites, any further wells would compound the impacts of intensive well development as described above.

Construction of Powerlines. Powerlines to transmit generated energy from production sources to consumption sites carry the potential of impacting archaeological sites along the entire powerline corridor. Particularly, the development of access roads,

movement of equipment, foundation laying and tower construction could result in the destruction of any category of site identified within the study area, and might equally impact yet undefined site types far outside the limited region given scrutiny here.

Production and Use. Actual energy production would have little direct impact on any category of archaeological site. Brioli (1974) notes that ground surface subsidence may occur with sustained production but it is not possible at present to specify the quality or intensity of impact which this might produce. The most pronounced impacts anticipated from severe subsidence would be alteration of the depositional contexts of Site Categories 1, 2 and 6.

Maintenance. Impacts from repair and monitoring would be indirect, deriving principally from the presence of maintenance personnel who might engage in surface collection of cultural materials.

Closeout Stage

Abandon Wells. No impact.

Remove Wells. Physical removal of constructions to the extent that equipment movement is confined to existing roads would not impact archaeological sites. Presumably no cultural resources, save portions of the largest sites of Category 1, would remain at any location where the entire scenario of development had been played out. Off-site impacts on surrounding archaeological sites of all categories would be proportional to the extent that equipment movement and surface disturbance deviated from existing roads.

Surface Reclamation and Rehabilitation. Again, it is unlikely that any save the largest sites (Category 1) would have survived, even in part, to this stage of the closeout operations. Even fragmentary resources, however, might preserve an information content which could be further eroded by the removal of roads and intensive seeding.

Wendel-Amedee Study Area

(2) Nonelectrical Development

Because archaeological resources in the study area tend to be very limited in geographic extent, seldom exceeding at the largest a few acres, many of the stages of nonelectrical development of geothermal energy carry the potential for impacts as high as those deriving from electrical development. For example, all stages of preliminary exploration and exploratory drilling should effectively be considered identical in terms of archaeological impacts for both varieties of development. While for nonelectrical purposes the stages of field development may be less extensive, and powerplant construction is not an element, their impacts on all categories of sites would be nonetheless severe. Closeout stages would not differ in impacts from electrical development.

Only at the production stage does nonelectrical development require specific discussion of impacts. Three potential modes of development are projected:

Food Product Processing. Assuming a 5-acre plant as the average development for food processing facilities, severe impact could be anticipated for all categories of site. Earth moving, laying of foundations, and construction on this scale would totally obliterate all preserving vertical components, contain contextual information the loss of which (through disturbance of deposits) would be of a high order of magnitude, even if disturbance were confined to a fraction of the site's surface. Realistically, caves, because of their inaccessible locations, should escape these impacts.

Greenhouses. Assuming a basic greenhouse unit of five acres with 2 acres of support facilities, greenhouse impacts would be of the same order of magnitude as those of food product processing; they would be severe on all categories of site.

Single Cell Protein Production. Twenty acres of ponds and support facilities would mix deposits and scatter surface remains for all categories of open sites and could obliterate all save the largest villages. Caves clearly are outside the impact zone of open-air cultural ponds.

b. Historical Resources

Because existing historical resources within the study area consist of disparate elements not groupable within descriptive categories, impacts upon them are discussed on an individual basis in the analysis of specific potential leasing units.

Island Study Area

a. Archaeological Resources

While the total configuration of archaeological sites on Honey Lake Island differs from that of the Wendel-Amedee area, no site categories are present which were not defined at Wendel-Amedee. Likewise, though ecologically less diverse, the magnitude of anticipated impacts on specific site categories (#2, Temporary Camps; #3, Lithic scatters/chipping assemblages; and #5, Isolated milling stations) would be the same for the two areas. For a discussion of these impacts, organized by stages of geothermal development, refer to Discrete Operations above.

b. Historical Resources

Because existing historical resources within the study area are sparse and are confined to a single potential leasing unit, impacts upon them are discussed on an individual basis in the analysis of specific leasing units.

Wendel-Amedee Study Area (Potential Leasing Units 1-7)

a. Archaeological Resources

The archaeological sensitivity to impacts of an individual potential leasing unit is a function of (1) the sheer number of archaeological sites; (2) their areal extent; (3) their National Register 'significance' (as gauged by their research potential and their integrity), and (4) their relative susceptibility to disturbance from the various stages of geothermal development.

The following discussion, an adjunct to TABLES 66, 67, 68 and 69, addresses the anticipated impacts of geothermal development on the total archaeological resource base of each leasing unit.

Potential Leasing Unit 1. Fifteen sites occur within this leasing unit, consisting of five villages, five camps, and five lithic scatters. Petroglyphs occur at two of these sites, and a third functions also as a quarry. Six of the sites fall within the Viewland Pass District, potentially eligible for inclusion on the National Register of Historic Places.

Impacts on the potential National Register District are judged considerably higher than those on other sites owing to (1) the much higher information content of the District, and (2) the easily impacted integrity of the constellation of sites.

Of the remaining sites within the leasing unit, high impacts are anticipated where exploratory drilling may affect the deposit of temporary camps. The more pronounced ground disturbing aspects of field development may result in high impacts on all categories of sites. No sites within the unit could absorb the impacts of powerplant construction, and additional well development would cause further high disturbances.

The overall leasing unit matrix (TABLES 66-69) identifies that portion of the unit in which no impacts to cultural resources are anticipated from the proposed leasing.

Potential Leasing Unit 2. Only one archaeological site lies within this leasing unit, consisting of a very small milling station. High impacts on the archaeological resource base are anticipated only from intensive well development, powerplant construction, and additional well development, all of which, injudiciously placed, might obliterate the site and eradicate its information content.

Potential Leasing Unit 3. Anticipated impacts on this leasing unit are generally low owing to the sparse archaeological resources present; only a single, diffuse lithic scatter lies within the unit and it would suffer chiefly from intensive well development, powerplant construction and additional well development.

Most of the unit is devoid of cultural resources. This is reflected in the overall leasing unit matrix (TABLES 66-69).

Potential Leasing Unit 4. Generally high impacts identified on the matrix for this leasing unit owe to the presence of two large village sites. All ground disturbing activities at the exploratory, development and production stages would contribute severely to the loss of information by altering horizontal contexts and mixing vertical deposits. Likewise, all nonelectrical developments, if occurring on site locations, would carry high impacts.

While very little of the leasing unit falls outside the precincts of the two sites, it is conceivable that development might proceed in the culturally sterile areas with relatively little impact. It should be noted, however, that development even in these peripheral zones would not be impact-free as the close proximity of the sites would make them highly susceptible to indirect impacts such as collection by construction and maintenance personnel and flooding from runoff. These concerns are reflected on the overall leasing unit matrix (TABLES 66-69).

Potential Leasing Unit 5. Of the 12 archaeological sites in this leasing unit, 6 fall within the Tupi' twaba potential National Register District. Accordingly, high to very high impacts are identified for all ground disturbing states of exploration and development. Construction in proximity to this district, in addition to increasing the potential for vandalism, would carry as well severe impacts on the district's integrity of setting.

Outside of the potential district lie five archaeological sites (including portions of two villages) on which the impacts of ground disturbing operations would be high to very high.

The overall Leasing Unit Matrix (TABLES 66-69) identifies those portions of the unit in which no impacts or low impacts on cultural resources are anticipated from proposed leasing.

Potential Leasing Unit 6. The archaeological resources of this unit consist only of two lithic scatters and an isolated milling station. While ground-disturbing aspects of development would have high to very high impacts on the area of the lithic scatters themselves, much of the unit would be relatively impact-free. This is reflected in the overall Leasing Unit Matrix (TABLES 66-69).

Potential Leasing Unit 7. This unit contains 13 archaeological sites, including the potential National Register nominee, Tommy Tucker Cave. While this important cave site, because of its location, is relatively safe from many categories of impact which would threaten exposed sites, and while, since it has been virtually totally excavated, its deposits are no longer susceptible to impact from ground disturbance, its potential National Register status confers upon it a high sensitivity to impacts on its integrity of setting such as would result from constructional aspects of development.

Remaining sites in the unit consist of a village, three camps, a lithic scatter, four additional caves, and three isolated milling stations. The village, camps, and lithic scatter are especially susceptible to high to very high impacts from ground-disturbing activities. Impacts on cave sites would be pronounced only where developments were concentrated on the spatially very limited cave locales.

The overall Leasing Unit Matrix identifies the few areas within the unit on which no or low impacts would occur.

b. Historical Resources

Because historical sites are, like archaeological ones, made up of unique configurations of physical remains, and because their historical information content often lies as much in the context of the remains as it does in their content, they are highly susceptible to impacts from activities which would alter their spatial patterning as well as to those which would contribute to their deterioration.

As the few existing historical resources within the study area defy categorization, they are discussed below individually, grouped by the leasing units in which they occur.

Leasing Unit 1

(1) Eagle Lake Ditch. Approximately 3/4 mile of this abandoned irrigation ditch crosses the unit. While most impacts on this very extensive remnant would be low, major land moving activities (as in exploratory drilling and field development) and construction (as in the production stage of both electrical and nonelectrical development) could obliterate its traces for the extent of the development.

Leasing Units 2, 3, and 4. No historical remains occur within the units.

Leasing Unit 5

(1) Eagle Lake Ditch. Approximately 1 mile of the ditch crosses the unit. Impacts would be as described in leasing unit 1.

Leasing Unit 6

(1) Historic Site HS 04-02-1. This abandoned homestead would suffer a significant reduction in its information content from any earth-moving or construction activities occurring on the site. As a consequence, high impacts are identified for the ground-disturbing aspects of exploratory drilling and field development, and for the production stages of both electrical and nonelectrical development.

(2) Eagle Lake Ditch. Nearly 2 miles of the ditch cross the unit. Impacts would be as described in leasing unit 1.

Leasing Unit 7

(1) Abandoned NC&O Railroad Grade. Approximately 1 mile of the abandoned grade crosses two small portions of the unit. While most impacts on the remnant would be low, particularly as it extends for many miles, local traces would be obliterated by major earth-moving activities and construction.

(2) Abandoned Kiln. This small, standing tufa-block structure will resist many impacts but could be destroyed by earth moving or construction activities concentrated on its locale.

(3) Pearson Massacre Site. The Pearson homestead site, at which the 1868 massacre occurred, is marked by a sign commemorating the event. Remnants of the homestead are gone, but the association of the location and its memorial would be impaired by construction.

(4) Amedee Town Site. While a small portion of the town site lies upon an isolated parcel of NRL, physical remains are no longer preserved. Nonetheless, the historical association of the old town site might be impaired by intrusive constructions.

(5) Eagle Lake Ditch. Approximately 3/4 mile of the ditch crosses the unit. Impacts would be as described above.

Island Study Area (Potential Leasing Units 8-11)

a. Archaeological Resources

The following discussion, an adjunct to Matrices 66 and 67, addresses the anticipated impacts of geothermal development on the total archaeological resource base of each leasing unit.

Potential Leasing Unit 8. Archaeological sites on this unit consist of two camps, five lithic scatters, and an isolated milling station. The camps and lithic scatter are subject to high to very high impacts from ground disturbing activities. Areas of no impact are identified on the overall Leasing Unit Matrix (TABLES 66-69).

Potential Leasing Unit 9. The nine archaeological sites within this unit, consisting of five camps, three lithic scatters, and an isolated milling station, fall within the potential National Register District 27N, 15E. Accordingly, all ground-disturbing activities would have high to very high impacts within the 560 acres of the potential District, and intrusive constructions could impact its integrity of setting even if occurring outside the District precincts.

Potential Leasing Unit 10. This unit, consisting almost entirely of private land with federally reserved mineral rights, has not been surveyed for cultural resources owing to the refusal of the principal landowner to allow passage for the purpose. Potential impacts, therefore, cannot be addressed at this time.

Potential Leasing Unit 11. The 320-acre potential National Register District 27N, 16E falls within this unit. The four occupation surfaces are accordingly ascribed a high to very high sensitivity to impacts from ground-disturbing activities and would suffer pronounced impacts on their integrity of setting from adjacent construction.

Wendel-Amedee Study Area - Cumulative Impacts

a. Archaeological Resources

Total leasing of all potential leasing units and its accompanying development could result in the virtual destruction of 47 archaeological sites. Since almost all of the these sites are smaller in area than would be the impact zones of the proposed developments, and because the locations of developments within each leasing unit will not be fixed until after leasing, impacts on the total cultural resource base must be judged, on a cumulative basis, as high to very high. The loss of irretrievable archaeological information would be enormous, and would not only eliminate the possibility of reconstructing the culture history of the northeastern Honey Lake margin, but also would deplete the store of data useful in generating broader statements on the nature and evolution of hunting-gathering cultures. Further, one site and two large districts potentially eligible for the National Register of Historic Places would have their integrity reduced to the point that their National Register eligibility would be seriously impaired.

b. Historical Resources

Total leasing and development would impair the integrity and reduce the information content of a large portion of the few fugitive remains of a century and a quarter of settlement. Because they are scarce, unique, and irreplaceable, the loss to history would be significant.

Island Study Area - Cumulative Impacts

a. Archaeological Resources

Total leasing of all potential leasing units could result in the destruction of 29 archaeological sites, significantly reducing the archaeological resource base of an area the prehistory of which remains virtually unknown. Both local culture history and general anthropological theory would be impoverished by the information loss. Impacts upon the integrity of two large archaeological districts would

seriously reduce (and perhaps eliminate) their potential eligibility for nomination to the National Register of Historic Places.

b. Historical Resources

Total leasing could annihilate the single archaeological resource remaining on NRL on Honey Lake Island. The scarceness of the resource invests a high assessment on the impacts of unmitigated development.

Wendel-Amedee and Island Area

a. Cultural Resources

Total leasing of all potential leasing units would result in the loss to archaeology and history of an enormous body of data which otherwise carries the potential for contributing importantly to scientific scholarship as well as enriching understanding of the American heritage. Without appropriate mitigation, this potential would be irreversibly diminished.

The remaining six camps and two lithic scatters are susceptible to high to very high impacts from all ground-disturbing activities. The small zone of no impacts is designated on the overall Leasing Matrix.

b. Historical Resources

The very limited historical resources occurring on NRL within the study area are confined to Potential Leasing Unit 8. Leasing Units 9 and 11, without preserved historical remains, would be therefore free of impacts on these values. Leasing Unit 10, which went unsurveyed for reasons specified above, remains unknown in terms both of resources and anticipated impacts.

Potential Leasing Unit 8. The single historical site (with three foci) recorded during the Island survey carries the potential for supplying useful information on the material culture of local homesteading activity in the first decade of the present century. Accordingly, and since it is the only such site on public lands on the Island, impacts which would fragment its remains and disturb their contexts must be regarded as high to very high. The most severe impacts would derive from the ground-disturbing activities of exploratory drilling and field development and from the constructional aspects of both electrical and nonelectrical development. As is the case with prehistoric sites, the contexts of historic remains, once disturbed without adequate recordation, cannot be reconstructed.

4. Social and Economic Values

Wendel-Amedee Study Area - Discrete Stages

Most potential socioeconomic impacts from geothermal leasing are not site specific but are cumulative in nature. In the interest of avoiding redundancy, these ubiquitous impacts are addressed only under the heading of cumulative impacts. Consequently, the socioeconomic impacts addressed under the heading of Wendel-Amedee Area are only those impacts which are peculiar to that area. Also no impact matrices for each discrete operation were tabulated.

Preliminary Exploration Stage. A crew of two or three people would be employed from one to four months at this stage. These people would probably stay in motel facilities in Susanville. No local employment would be generated.

Exploration Drilling Stage. This stage involves the use of large drilling rigs and the testing of wells. This would affect people living at Wendel (40 people) and Amedee (1 person) through noise and possible odor emissions. The use of the Wildlife Management Area west of Wendel could be reduced by exploration activities on the adjacent areas of Sections 23 and 24 proposed for lease in this EAR.

TABLE 51
IMPACTS OF NOISE ON HUMANS FROM
GEOTHERMAL WELL DRILLING AND TESTING*

Impact	Distance in Feet from Sources: Well Drilling	Distance in Feet from Sources: Muffled Well Testing
Intereference with sleep (threshold level:55 dBA)	1,500	6,000
Intereference with residential use (threshold level:65 bBA)	375	1,500
Hearing loss over prolonged period (threshold level:70 dBA)	187	750

*Data from Procunier, 1976 and USDI, 1973

TABLE 51 shows the impacts of noise on humans at various distances from well drilling and testing sites based on studies from The Geysers. Drilling and well testing on Sections 30 and 31, adjacent to Wendel, would have serious impacts on people residing there, ranging from loss of sleep to loss of hearing. Drilling on the national resource lands in Section 8, near the ranch residence at Amedee, would interfere with the use of that residence due to noise and possible hydrogen sulfide odor emissions.

Exploration on Section 10, T.29N., R.15E., might be incompatible with the scenic highway corridor indicated in the Lassen County General Plan.

Exploration in the Skedaddle Mountains, shown as a prime recreation area in the Lassen County General Plan, would interfere with some kinds of recreation while enhancing its value for other types of recreation through improved access. The County probably would not find geothermal exploration inconsistent with its plan because other areas of the County so designated have been developed for uses such as residential-recreational.

It should be noted that geothermal exploration impacts, such as those discussed above, cannot entirely be prevented by the Federal government. Most of the land in this area is in private ownership and could be explored without any Federal action, resulting in the same type of impacts.

Twenty to 30 people would be employed at this stage. Most of these people would come from outside of Lassen County and would seek to park campers and trailers or live in motels for the duration of exploration. Since there are no facilities available in the Wendel-Amedee area, these people would live outside of that area. This impact is discussed under cumulative impacts. Perhaps 10 percent of these people would seek to park a mobilehome or camper in the vicinity of Wendel for the duration of their employment.

Field Development Stage. Development of a geothermal powerplant in the Wendel-Amedee area would enlarge upon the socioeconomic impacts of exploration. The principal difference between the effects of a 50 MW plant versus two 100 MW plants is in the number of people employed during the development stage. One hundred and twenty to 200 people would be employed for one to two years at this stage. However, most would live outside of the Wendel-Amedee area due to the lack of services.

This type of land use plus the development itself would contribute substantially to a change in the character of the area from that of open space to industrial and residential.

The development of nonelectric uses would probably have fewer socioeconomic impacts on the Wendel-Amedee area. This is due to the much smaller capital investment required for units like agricultural greenhouses. In any case, whether larger or smaller, the nonelectrical development employment impacts would primarily occur where public services and housing exist outside of the Wendel-Amedee area.

Production Stage. Ten to 20 people would be employed full-time to operate a 50 to 200 MW powerplant. There would be periodic employment for 20 to 30 people in the drilling of replacement wells to maintain the geothermal field. About one-half, or 10, of the full-time employees would seek to live in the Wendel-Amedee area. This would result in 10 new single-family dwellings. The location of these dwellings would probably be at Wendel or along the existing road from Highway 395 to Amedee.

Operation of a nonelectric geothermal development could employ more people than a powerplant. As shown in TABLE 20 for the nonelectrical model, a 100 acre agri-industrial site (the maximum for each lease unit) could employ 174 people. Many of the people employed for the food processing activity would be employed for only part of the year. Most people would choose to live where services are now available, outside of the Wendel-Amedee area.

The greatest property tax revenues to Lassen County and its schools would be derived during the operation stage of the powerplant. Using estimates based on The Geysers, California, the annual property tax would be 250 thousand to one million dollars from a 50 to 200 MW plant. The tax revenues would vary with the productivity of the field and the price of electricity.

Closeout Stage. Closedown would result in the departure of families living in the area who are dependent upon employment in the operation of the geothermal field. This would effect 10 families within the Wendel-Amedee area. The result would be scattered dwellings having an appearacne of abandonment or lack of maintenance. The appearance of these dwellings would not be dissimilar to the present appearance of Wendel.

Island Study Area - Discrete Stages

Preliminary Exploration Stage. The two or three people employed at this stage would probably seek motel accommodations at one of the motels along Highway 395. There would be no noticeable socio-economic impact in The Island area.

Exploration Drilling Stage. Since there are no services or accommodations of any sort on The Island, all employees at the exploration stage would have to live elsewhere. The most likely site is the community of Herlong. Facilities for travelers and vacant housing are very scarce. Most of the people employed at this stage, probably 20 to 30, would live in mobilehomes or campers on the existing mobilehome sites and vacant lots in the community. Perhaps five new permanent single-family dwellings would be located at Herlong in addition to the temporary parking of mobilehomes and campers.

Probably six or fewer local people would be employed at this stage due to the absence of the necessary specialized skills in the local labor force. There would be perhaps another six jobs created in Herlong by construction of additional housing facilities.

Field Development Stage. The development of a 50 to 200 MW powerplant would increase the impacts noted under the exploration stage. There would be 120 to 200 people employed in the construction of a powerplant and its ancillary facilities for about two years.

The most likely place for people to locate is at Herlong where the schools and other public facilities are presently available. However, nowhere in this area is there adequate housing available for this number of additional people. As a result, some people would commute from Susanville and Reno.

Probably 75 percent, or 90 to 150, of these people would seek housing around Herlong. Due to the temporary nature of the increased demand for housing, most of the units which would be installed would be mobilehomes. Several new mobilehome parks would probably be built and then abandoned when the construction of the powerplant was completed. In addition, the rental prices in the Herlong area would be escalated. People on fixed incomes and/or low incomes and retired people would either be displaced or have to pay much higher rent.

The existing school, water, sewer, public health and protective services would all probably be inadequate to serve this temporary influx of people. The situation at Herlong would carry many of the characteristics of a boom town.

The model nonelectric geothermal development would be possible without the "boom town" impacts mentioned above. Since nonelectric uses could be developed at a more gradual pace than a powerplant, the impacts could be both spread out over a longer period of time and be less in total.

Production Stage. The operation of a 50 to 200 MW powerplant would require the services of 10 to 20 full-time employees. An additional 20 to 30 people would occasionally be employed in the drilling of new wells to maintain the field. The full-time employees would all come from outside the area due to the special skills involved. They would probably choose to live at Herlong. Due to the reduction in employment at the end of the previous development stage, these people would find adequate housing available to them at Herlong.

Nonelectric development could employ more people at the operation stage than a powerplant. A 100-acre agri-industrial site could employ 174 people; some of these would be employed for only part of the year.

Closeout Stage. Closedown of the geothermal development would mean that the people who had been employed in its operation would leave the community. This would result in permanently vacant housing in the community because there would not be sufficient community growth to absorb this loss.

Wendel-Amedee Area - Potential Leasing Units 1-7

Potential Leasing Unit 1. The part of Unit 1 in Section 10 falls within the scenic highway corridor shown on the Lassen County General Plan. The scenic corridor has been evaluated in terms of visual resource management classes as defined in BLM Manual releases. Exploration and development will be considered with respect to each VRM class (see Aesthetics).

Potential Leasing Unit 2. This unit lies within an area shown in the Lassen County General Plan as a prime recreation area. All of this prime recreation area has been included in BLM's visual resource management class II. Since some exploration, development and operation activities would interfere with some recreation uses, exploration and development in this unit may be considered inconsistent with the County Plan.

Potential Leasing Unit 3. No specific socioeconomic impacts in this leasing unit.

Potential Leasing Unit 4. In this unit the government only controls the mineral resources, not the surface. The surface is in agricultural use. It is also next to the Wildlife Area.

Exploration, development and operation on this unit would prevent agricultural use of all disturbed areas until the equipment was removed. It would then have reduced productivity for many years. All of these activities would reduce the value of the adjacent Wildfowl Management Area by reducing its habitat value and thus correspondingly reducing its productivity for hunting. Hunting on the proposed leasing unit might be further restricted to prevent damage to geothermal facilities.

Potential Leasing Unit 5. The southern part of this unit lies within the scenic highway corridor shown on the Lassen County General Plan. The scenic highway corridor will be evaluated in terms of visual resource management classes (see Aesthetics). Exploration, development and operation may be considered incompatible with that plan. Well testing in the southern end of this unit would interfere with the sleep of people living in the Wendel area.

Potential Leasing Unit 6. The part of this unit in Sections 30 and 31 lies within a scenic highway corridor shown in the Lassen County General plan. The scenic highway corridor will be evaluated in terms of visual resource management classes (see Aesthetics). Also well drilling and testing in this part of Unit 6 would interfere with sleep and residential use in the Wendel area. Interference with sleep would occur within 6,000 feet from muffled well testing and within 1,500 feet from well drilling. Interference with residential use would occur within 1,500 feet of muffled well testing.

Hearing loss over a prolonged period could result for Wendel area residents living within 750 feet of muffled well testing. This would affect the eastern part of the settlement if a well were tested near the boundary of the leasing unit.

Potential Leasing Unit 7. This leasing unit lies within a scenic highway corridor shown on the Lassen County General Plan. The scenic highway corridor will be evaluated in terms of visual resource management classes (see Aesthetics). Exploration and development within the corridor may be considered inconsistent with the Plan.

Island Area - Potential Leasing Units 8-11

Potential Leasing Units 8 and 9. No specific socioeconomic impacts have been identified.

Potential Leasing Unit 10. The Federal government controls the mineral resource in this unit but not the surface; the surface is in private ownership. The surface is currently being used to grow alfalfa. Exploration, development and operation in this unit would take most of the land out of agricultural production. If these activities were to release the type of materials into the atmoshpere which have been released at The Geysers, the productivity of the adjacent off-lease alfalfa fields would also be reduced.

Potential Leasing Unit 11. This unit is currently being used for cattle grazing. Exploration, development and operation in this unit would interfere with that use, but not entirely eliminate it. Existing fences and water structures might have to be moved or removed.

Wendel-Amedee Area - Cumulative Impacts

Preliminary Exploration Stage. There would be no noticeable socioeconomic impact during the preliminary exploration stage. Employment at this stage would consist of two to four people working in the area for one to six months. None of these people would be from the local area. Little, if any, property tax would accrue to the County because there is little value to assess until wells have been successfully drilled.

Drilling Exploration Stage. Exploration of the entire area proposed for lease in this action would take one to five years.[1/] This would employ 20 people full time on well drilling and three to 12

1/ Assumptions: Eight to 21 exploratory wells, one drill rig, two to three months per well drilling time.

people part time on drill-pad preparation and road construction. None of the drilling crew would be taken from the local labor force. Probably most of the part-time employment would go to local people. Most of these people could be housed in existing facilities. In the Herlong area, some additional construction of housing facilities could result due to the absence of vacant housing.

The only taxable property on the lease at this time would be the drilling equipment. If the equipment had an assessed value of $500,000, the property tax revenue would be 35 to 40 thousand dollars per year.

Field Development Stage. The development of a 50 to 200 MW powerplant would involve more well drilling, powerplant construction, setting pipe from well to plant and transmission line construction. This would provide peak employment for 120 to 200 people. Development would take two to three years.

Most of the employment would go to people from outside the Susanville-Honey Lake area due to the specialized skills required and labor union structure. Employment of locals would constitute 10 to 20 percent of the total. Secondary employment in the Susanville-Honey Lake area, resulting from local spending of construction firms and their employees, would add another 30 to 50 jobs during this period. Most of these jobs would be in the services and construction sectors and would go to local people.

If this plant were to be located in the Wendel-Amedee area, most of the employees coming from outside the area would choose to live between Susanville and Litchfield. They would do so because this area is relatively close to the job, has room for expansion and has existing public services available.

The result of this growth would be intensification of the present suburban sprawl from Susanville to Litchfield. There would probably be stress on some services such as health, water, schools, electricity, and telephones. Since the growth would only be temporary, unless other development projects were to follow, only temporary solutions would be needed. For example, the elementary school at Litchfield would probably have to be supplemented with one to three mobilehome classrooms.

The property tax effects of the development stage are uncertain but could be expected to vary between the levels at exploration and production. A principal variable would be the County Assessor's policy on the value of leases and wells which are not in production.

Development of nonelectrical uses such as hydroponic greenhouses at Hobo Wells by Wendel, would have less impact than a powerplant because they can be implemented in smaller increments.

Development of a 50 to 200 MW powerplant at The Island would employ the same number of people as previously described for the Wendel-Amedee area. The impacts on the Herlong area would be different, however. This stems primarily from the smaller size of the Herlong community and its capacity to absorb the influx of people. Some of the work force for this area would commute from the Reno area. Perhaps 25 to 50 percent of the workers would commute, depending upon the difficulty of finding a place to live in the Herlong area. The impacts on Herlong have previously been discussed as part of the impacts on The Island area from leasing.

The previous discussion of nonelectrical development relative to the Wendel-Amedee area is also applicable to The Island area and is not repeated here.

At the end of the development stage, employment from a powerplant and many nonelectric uses, would decline sharply. Housing and other facilities enlarged to serve the influx of people would fall into disuse or underuse. The settlement at Litchfield would have many vacant homes and trailer sites. Herlong would also take on the appearance of "bust" after a boom.

Production Stage. Ten to 20 people would be employed full time to operate a 50 to 200 MW powerplant. In addition, 20 to 30 people would be employed occasionally to drill replacement wells. Two or three of these people would come from the local labor force, the others would be people trained in steam powerplant operation and geothermal field maintenance. As a result of the post-development decline in employment, these people would find plenty of housing available. However, if other developments were starting up in the area, housing might continue to be scarce.

The operation stage for a nonelectrical development could employ more people than an electrical development. As described in the nonelectrical model in TABLE 20, approximately 156 people could be employed at a 100-acre agri-industrial site. Many of those employed for food processing would be only seasonally employed. If a development of this nature is implemented, the area from Susanville to Litchfield and Wendel would experience increased residential development. This sort of growth would necessitate the expansion of all public services in that area. The most critical need might be for community sewage and water systems. No estimate of cost is available at this time.

The annual property tax revenue from a 50 to 200 MW powerplant facility would be 250 thousand or one million dollars, respectively.[2/] This estimate is based on The Geysers development. The tax revenues would vary with the productivity of the field and the price of electricity.

2/ Assumptions: Market value is $284,000 per MW; the tax rate is $7.00 per $100 of assessed value; the assessment ratio is 0.25.

Closeout Stage. The main impacts of this stage would be loss of jobs and loss of property tax revenue. The people employed would probably leave the Honey Lake area and seek employment elsewhere. This would be the same pattern of events which followed the closure of the large lumber mill at Westwood, Lassen County, in 1957. The close-down of the powerplant would mean the loss of the 10 to 20 jobs involved in its operation. Tax revenues would decline because the powerplant would either be removed or reduced in value on the County tax assessor's rolls.

D. Overall Environmental Impact Matrix

The overall environmental impact matrices (TABLES 70 and 71) cover those resources for which an individual impact matrix was done by the respective resource Specialists. Major components for each resource were defined by the resource Specialists. The same major components were used for analysis of electrical and nonelectrical development as indicated in the individual matrices. For each resource component, an impact rating was recorded for each discrete operation, based on an average of the impact ratings for all 11 potential leasing units. It should be noted that these ratings reflect unmitigated impacts. One should refer to the mitigation section to see how specific impacts are handled.

For Geology and Socio-Economic Resources, an impact matrix was not done. It was felt that these two resources varied so insignificantly on an individual potential leasing unit basis that an impact matrix was not necessary. For Air, the major components are the same as those used on the individual potential leasing units. The impacts for some discrete operations are shown as unknown. At this point in time it is impossible to assess these impacts of development because the existing data on the geothermal reservoir for the Wendel-Amedee area does not allow us to predict just what the impacts will be. Until more data is made available, the impacts will remain unknown. This situation is addressed in both the impact and mitigation sections.

The numbers in the component column for Soils represent soil associations that have already been defined. The impacts for each association have been averaged and recorded with respect to each discrete operation. The assignment of a plus/minus ($\pm$) to an impact rating reflects the specialists attempt to indicate that if the geothermal fluids are of adequate quality and quantity, their impact for agricultural irrigation could be highly beneficial. There is also the potential that the fluids will be unsatisfactory for agricultural use and therefore improper disposal of geothermal fluids could be a highly adverse impact on soils. For Water the average impacts for major components are self-explanatory.

Under Living Components, the impacts for all terrestrial plants were so similar that they were not broken down into the individual vegetative groups. The ratings for Raptors and Endangered and Threatened Species are indicated as being moderately (-M) negative. For these two components an average rating is particularly misleading. Ratings on the individual matrices tend to be either high to very high or zero. There is very little reference to moderate impacts. Yet an overall average for 11 potential leasing units puts the average at a moderate level. This should not lead one to underestimate the potential impact to these two components.

For Archaeology and Cultural Resources the impact ratings were broken into group A and B. Group A ratings are for these areas identified by the resource specialist as having a distinctly higher sensitivity to impacts when compared to group B. This is not to say that group B is devoid of archaeological or cultural resources. Group A and B are only identified on the individual matrices by the degree of impacts throughout the discrete operation analysis. The differentiation is only comparative.

HONEY LAKE VALLEY GEOTHERMAL PROJECT - Soils (Electrical)

Table 52

Potential Leasing Unit	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
UNIT # 1																			
419	0	0	-L	-M	-M	0	-H	-M	0	±H	-L	-L	-M	-L	0	0	-L	-L	+H
4063	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	-M	-H	-L	0	0	-L	-L	+H
UNIT # 2																			
4063	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	-M	-H	-L	0	0	-L	-L	+H
4064	0	0	-M	-H	H	0	-H	-H	0	-H	-L	-M	-H	-L	0	0	-L	-L	+H
UNIT # 3																			
4063	0	0	-M	-H	H	0	-H	-H	0	-H	-L	-L	-H	-L	0	0	-L	-L	+H
UNIT # 4																			
423	0	0	L	-L	-L	0	-M	-M	0	±H	-L	-L	-M	-L	0	-L	-L	-L	+H
UNIT # 5																			
419	0	0	-L	-M	-M	-M	-H	-M	0	±H	-L	-L	-L	-L	0	0	-L	-L	+H
4063	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	-M	-L	-L	0	0	-L	-L	H
UNIT # 6																			
419	0	0	-M	-M	-M	0	-H	-M	0	±H	-L	-M	-L	-L	0	0	-L	-L	+H
423	0	0	-L	-L	-L	0	-M	-L	0	±H	-L	-M	-L	-L	0	0	-L	-L	+H
UNIT # 7																			
419	0	0	-L	-M	-M	0	-H	-M	0	±H	-L	-L	-M	-L	0	0	-L	-L	+H
423	0	0	-L	-L	-L	0	-M	-M	0	±H	-L	-L	-L	-L	0	0	-L	-L	+H
4063	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	-M	-H	-L	0	0	-L	-L	+H
420	0	0	0	0	0	0	-M	-L	0	±H	-L	-L	-L	-L	0	0	-L	-L	+H
UNIT # 8																			
426	0	0	0	0	0	0	-M	-L	0	±H	-L	-L	-L	-L	0	0	-L	-L	+H

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - Soils (Electrical) Table 52 (Continued)

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
UNIT # 9																			
426	0	0	0	0	0	0	-L	-L	0	±H	-L	-L	-L	-L	0	0	-L	-L	+H
UNIT # 10																			
425	0	0	0	0	0	0	-L	-L	0	±H	-L	-L	-L	-L	0	0	-L	-L	+H
426	0	0	0	0	0	0	-L	-L	0	±H	-L	-L	-L	-L	0	0	-L	-L	+H
UNIT # 11																			
426	0	0	0	0	0	0	-L	-L	0	±H	-L	-L	-L	-L	0	0	-L	-L	+H
Other NRL Buffer																			
419	0	0	-L	-L	-L	0	-H	-M	0	±H	-L	-L	-M	-L	0	0	-L	-L	+H
4063	0	0	-H	-H	-H	0	-H	-H	0	-H	-L	-M	-H	0	0	0	-L	-L	+H
4064	0	0	-H	-H	-H	0	-H	-H	0	-H	-L	-M	-H	0	0	0	-L	-L	+H

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - Soils (Nonelectrical)

Table 53

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
UNIT # 1																	
419	0	0	-L	-M	-M	0	-H	-M	0	±H	-L	-L	-L	-L	0	0	+H
4063	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	-L	-L	-L	0	0	+H
UNIT # 2																	
4063	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	-L	-L	-L	0	0	+H
4064	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	-L	-L	-L	0	0	+H
UNIT # 3																	
4063	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	-L	-L	-L	0	0	+H
UNIT # 4																	
423	0	0	-L	-L	-L	0	-M	-M	0	±H	-L	-L	-L	-L	-L	-L	+H
UNIT # 5																	
419	0	0	-L	-M	-M	0	-H	-M	0	±H	-L	U	L	U	0	0	+H
4063	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	U	-M	U	0	0	H
UNIT # 6																	
419	0	0	-M	-M	-M	0	-H	-M	0	±H	-L	-L	-L	-L	-L	-L	+H
423	0	0	-L	-L	-L	0	-M	-L	0	±H	-L	-L	-L	-L	-L	-L	+H
UNIT # 7																	
419	0	0	-L	-M	-M	0	-H	-M	0	±H	-L	-L	-L	-L	-L	-L	+H
423	0	0	-L	-L	-L	0	-M	-M	0	±H	-L	-L	-L	-L	-L	-L	+H
4063	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	-L	-L	-L	-L	-L	+H
420	0	0	0	0	0	0	-M	-L	0	±H	-L	-L	-L	-L	-L	-L	+H

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - Soils (Nonelectrical) Table 53 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
UNIT # 8																	
426	0	0	0	0	0	0	-M	-L	0	±H	-L	-L	-L	-L	-L	-L	+H
UNIT # 9																	
426	0	0	0	0	0	0	-L	-L	0	±H	-L	-L	-L	-L	-L	-L	+H
UNIT #10																	
425	0	0	0	0	0	0	-L	-L	0	±H	-L	-L	-L	-L	-L	-L	+H
426	0	0	0	0	0	0	-L	-L	0	±H	-L	-L	-L	-L	-L	-L	+H
UNIT #11																	
426	0	0	0	0	0	0	-L	-L	0	±H	-L	-L	-L	-L	-L	-L	+H
Other NRL Buffer																	
419	0	0	-L	-L	-L	0	-H	-M	0	±H	-L	-L	-L	-L	-L	-L	+H
4063	0	0	-H	-H	-H	0	-H	-H	0	-H	-L	-L	-M	-L	-L	-L	+H
4064	0	0	-H	-H	-H	0	-H	-H	0	-H	-L	-L	-M	-L	-L	-L	+H

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH- Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - Water (Electrical)

Table 54

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION: Air-borne	PRELIMINARY EXPLORATION: Off-Road (Foot)	PRELIMINARY EXPLORATION: Off-Road Vehicle	EXPLORATORY DRILLING: Road Const. & Use	EXPLORATORY DRILLING: Drill Site Dev.	EXPLORATORY DRILLING: Drill-ing	EXPLORATORY DRILLING: Well Test-ing	FIELD DEVELOPMENT: Int. Well Dev.	FIELD DEVELOPMENT: Well Vent-ing	FIELD DEVELOPMENT: Waste Dis-posal	FIELD DEVELOPMENT: Pipe-line Dev.	FIELD DEVELOPMENT: Power Plant Const.	PRODUCTION OF ENERGY: Add'l Well Dev.	PRODUCTION OF ENERGY: Const. Power Lines	PRODUCTION OF ENERGY: Prod. & Use	PRODUCTION OF ENERGY: Main-ten-ance	CLOSE OUT: Aban-don Wells	CLOSE OUT: Re-move Equip. & Rehab.	CLOSE OUT: Surface Reclam-ation
UNIT # 1																			
Run-off	0	0	-L	-M	-M	0	-H	-H	0	-H	0	-L	-L	-L	0	0	0	0	+H
Ground Water	0	0	0	0	0	-H	-H	-H	0	-H	0	0	-H	0	0	0	0	0	0
UNIT # 2																			
Run-off	0	0	-M	-M	-L	0	-H	-H	0	-H	0	-H	-L	-L	0	-L	-L	-L	+H
Ground Water	0	0	0	0	0	-H	-H	-H	0	-H	0	0	-H	0	0	0	0	0	0
Recharge	0	0	0	-L	-L	0	-L	-H	0	-H	0	-H	0	0	0	0	0	0	+M
UNIT # 3																			
Run-off	0	0	-L	-M	-M	0	-H	-M	0	-H	0	-M	-M	0	0	-L	0	0	+H
Ground Water	0	0	0	0	0	0	-H	-H	0	-H	0	0	0	0	0	0	0	0	0
UNIT # 4																			
Ground Water	0	0	0	0	0	0	-H	-H	0	-H	0	0	0	0	0	0	0	0	0
UNIT # 5																			
Run-off	0	0	-L	-M	-M	0	-H	-M	0	-H	0	-L	-L	-L	0	0	-L	-L	+H
Ground Water	0	0	0	0	0	-H	-H	-H	0	-M	0	0	0	0	0	0	0	0	0
UNIT # 6																			
Run-off	0	0	-L	-M	-M	0	-H	-M	0	-H	0	-L	-L	-L	0	0	0	0	+H
Ground Water	0	0	0	0	0	-H	0	0	0	-H	0	0	0	0	0	0	0	0	0
Wendel Creek	0	0	-M	-M	-M	0	-H	-M	0	-H	0	-M	-L	-L	-L	-L	-L	-L	+H
UNIT # 7																			
Run-off	0	0	-L	-M	-M	0	-H	-M	0	-H	0	-M	-L	0	0	0	-L	-L	+H
Ground Water	0	0	0	0	0	-H	0	0	0	-H	0	0	0	0	0	0	0	0	0
Recharge	0	0	0	-L	-L	0	-H	-L	0	-H	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - Water (Electrical)

Table 54 (Continued)

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
UNIT # 8																			
Ground Water	0	0	0	0	0	-H	0	-H	0	-H	0	0	0	0	0	0	0	0	0
UNIT # 9																			
Ground Water	0	0	0	0	0	-H	0	-H	0	-H	0	0	0	0	0	0	0	0	0
UNIT #10																			
Ground Water	0	0	0	0	0	-H	0	-H	0	-H	0	0	0	0	0	0	0	0	0
UNIT #11																			
Ground Water	0	0	0	0	0	-H	0	-H	0	-H	0	0	0	0	0	0	0	0	0
Other NRL,																			
Buffer																			
Wendel Creek																			
Sediment	0	0	-L	-H	-H	-L	-H	-H	0	-H	0	0	-L	-L	-L	-L	-L	-L	+H
W.Q.	0	0	-L	-M	-H	-L	-H	-H	0	-H	0	0	-H	-L	0	0	-L	-L	+H
Run-off	0	0	-L	-M	-M	-M	0	-L	0	-L	0	0	-L	0	0	0	0	0	+H
Recharge	0	0	0	-L	-L	0	-L	-L	0	0	0	0	0	0	0	0	0	0	+H
Ground Water	0	0	0	0	0	-H	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - Water (Nonelectrical)

Table 55

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
UNIT # 1																	
Run-off	0	0	-L	-M	-M	0	-H	-H	0	-H	-L	0	0	0	0	0	+H
Ground Water	0	0	0	0	0	-H	-H	-H	0	-H	0	0	0	0	0	0	0
UNIT # 2																	
Run-off	0	0	-M	-M	-L	0	-H	0	0	-H	0	0	0	0	-L	-L	+H
Ground Water	0	0	0	0	0	-H	-H	-H	0	-H	0	0	0	0	0	0	0
Recharge	0	0	0	-L	-L	0	-L	0	0	-H	0	0	0	0	0	0	+M
UNIT # 3																	
Run-off	0	0	-L	-M	-M	0	-H	-M	0	-H	0	0	0	0	0	0	+H
Ground Water	0	0	0	0	0	0	-H	-H	0	-H	0	0	0	0	0	0	0
UNIT # 4																	
Ground Water	0	0	0	0	0	0	-H	-H	0	-H	0	0	0	0	0	0	0
UNIT # 5																	
Run-off	0	0	-L	-M	-M	0	-H	0	0	-H	0	0	0	0	-L	-L	+H
Ground Water	0	0	0	0	0	-H	-H	-H	0	0	0	0	0	0	0	0	0
UNIT # 6																	
Run-off	0	0	-L	-M	-M	0	-H	0	0	-H	0	0	0	0	0	0	+H
Ground Water	0	0	0	0	0	-H	0	0	0	0	0	0	0	0	0	0	0
Wendel Creek	0	0	-M	-M	-M	0	-H	-M	0	-H	-M	0	0	-L	-L	-L	+H

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - Water (Nonelectrical) Table 55 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION: Air-borne	PRELIMINARY EXPLORATION: Off-Road (Foot)	PRELIMINARY EXPLORATION: Off-Road Vehicle	EXPLORATORY DRILLING: Road Const. & Use	EXPLORATORY DRILLING: Drill Site Dev.	EXPLORATORY DRILLING: Drill-ing	EXPLORATORY DRILLING: Well Test-ing	FIELD DEVELOPMENT: Int. Well Dev.	FIELD DEVELOPMENT: Well Vent-ing	FIELD DEVELOPMENT: Waste Dis-posal	FIELD DEVELOPMENT: Pipe-line Dev.	NON-ELECTRICAL PRODUCTION: Food Pro-duct Proc.	NON-ELECTRICAL PRODUCTION: Green Houses	NON-ELECTRICAL PRODUCTION: Single Cell Protein Prod.	CLOSE OUT: Aban-don Wells	CLOSE OUT: Re-move Equip. & Rehab.	CLOSE OUT: Surface Reclama-tion
UNIT # 7																	
Run-off	0	0	-L	-M	-M	0	-H	0	0	-H	0	0	0	0	-L	-L	+H
Ground Water	0	0	0	0	0	-H	0	0	0	-H	0	0	0	0	0	0	0
Recharge	0	0	0	-L	-L	0	-L	-L	0	0	0	0	0	0	0	0	0
UNIT # 8																	
Ground Water	0	0	0	0	0	-H	0	0	0	-H	0	0	0	0	0	0	0
UNIT # 9																	
Ground Water	0	0	0	0	0	-H	0	0	0	-H	0	0	0	0	0	0	0
UNIT #10																	
Ground Water	0	0	0	0	0	-H	0	0	0	-H	0	0	0	0	0	0	0
UNIT #11																	
Ground Water	0	0	0	0	0	-H	0	0	0	-H	0	0	0	0	0	0	0
Other NRL																	
Buffer																	
Wendel Creek																	
Sediment	0	0	-L	-H	-H	-L	-H	-H	0	-H	0	0	0	0	-L	-L	+H
Water Quality	0	0	-L	-M	-H	-L	-H	-H	0	-H	0	0	0	0	-L	-L	+H
Run-off	0	0	-L	-M	-M	-M	0	-L	0	-L	0	0	0	0	0	0	+H
Recharge	0	0	0	-L	-L	0	-L	-L	0	0	0	0	0	0	0	0	+H
Ground Water	0	0	0	0	0	-H	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

AIR/NOISE

HONEY LAKE VALLEY GEOTHERMAL PROJECT (Electrical)

Table 56

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CL[illegible]		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
AIR																			
Movement Patterns	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temperature & Humidity	0	0	0	0	0	0	U	0	U	0	0	0	0	0	U	0	0	0	0
Part. Matter	0	0	-L	-L	-L	0	-L	-L	-L	-L	-M	-L	-L	-L	-L	0	+L	0	+L
Noxious Gases	0	0	-VL	-VL	0	U	U	0	U	-L	0	0	0	0	U	0	+L	0	0
Non Ionizing Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NOISE	0	0	0	-L	-L	-H	-M	-L	-H	0	-L	-L	-L	-L	-L	0	+L	0	0
# 1 AIR																			
Part. Matter	0	0	0	VL	-VL	0	-VL	-L	-VL	-VL	-L	-VL	-VL	-VL	-L	0	0	0	+L
Noxious Gases	0	0	0	0	0	0	-U	0	-U	0	0	0	0	0	U	0	+L	0	0
NOISE	0	0	0	-L	-L	-L	-L	-L	-L	0	-L	-L	-L	-L	-L	0	+L	0	0
# 2 AIR																			
Part. Matter	0	0	0	-VL	-VL	0	-VL	-L	-VL	-VL	-L	-VL	-VL	-VL	-L	0	0	0	+L
Noxious Gases	0	0	0	0	0	0	-U	0	-U	0	0	0	0	0	U	0	+L	0	0
NOISE	0	0	0	-M	-M	-H	-H	-M	-H	0	-M	-M	-M	-M	-M	0	+L	0	0
# 3 AIR																			
Part. Matter	0	0	0	-VL	-VL	0	-VL	-L	-VL	-VL	-L	-VL	-VL	-VL	-L	0	0	0	+L
Noxious Gases	0	0	0	0	0	0	-U	0	-U	0	0	0	0	0	U	0	+L	0	0
NOISE	0	0	0	-L	-L	-M	-M	-L	-M	0	-L	-L	-L	-L	-L	0	+L	0	0

Impact Ratings: U-Unknown, 0-None, VL-Very Low, L-Low, M-Moderate, H-High, VH-Very High

AIR/NOISE

HONEY LAKE VALLEY GEOTHERMAL PROJECT (Electrical)

Table 56 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
# 4 AIR																			
Part. Matter	0	0	0	-VL	-VL	0	-VL	-L	-VL	-VL	-L	-VL	-VL	-VL	-L	0	0	0	+L
Noxious Gases	0	0	0	0	0	0	-U	0	-U	0	0	0	0	0	U	0	+L	0	0
NOISE	0	0	0	-L	-L	-M	-M	-L	-M	0	-L	-L	-L	-L	-L	0	+L	0	0
# 5 AIR																			
Part. Matter	0	0	0	-VL	-VL	0	-VL	-L	-VL	-VL	-L	-VL	-VL	-VL	-L	0	0	0	+L
Noxious Gases	0	0	0	0	0	0	-U	0	-U	0	0	0	0	0	U	0	+L	0	0
NOISE	0	0	0	-L	-L	-L	-L	-L	-L	0	-L	-L	-L	-L	-L	0	+L	0	0
# 6 AIR																			
Part. Matter	0	0	0	-VL	-VL	0	-VL	-L	-VL	-VL	-L	-VL	-VL	-VL	-L	0	0	0	+L
Noxious Gases	0	0	0	0	0	0	-U	0	-U	0	0	0	0	0	U	0	+L	0	0
NOISE	0	0	0	-L	-L	-M	-M	-L	-M	0	-L	-L	-L	-L	-L	0	+L	0	0
# 7 AIR																			
Part. Matter	0	0	0	-VL	-VL	0	-VL	-L	-VL	-VL	-L	-VL	-VL	-VL	L	0	0	0	+L
Noxious Gases	0	0	0	0	0	0	-U	0	-U	0	0	0	0	0	U	0	+L	0	0
NOISE	0	0	0	-L	-L	-M	-M	-L	-M	0	-L	-L	-L	-L	-L	0	+L	0	0
# 8 AIR																			
Part. Matter	0	0	0	-VL	-VL	0	-VL	-L	-VL	-VL	-L	-VL	-VL	-VL	-L	0	0	0	+L
Noxious Gases	0	0	0	0	0	0	-U	0	-U	0	0	0	0	0	U	0	+L	0	0
NOISE	0	0	0	-L	-L	-L	-L	-L	-L	0	-L	-L	-L	-L	-L	0	+L	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

AIR/NOISE

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Table 56 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSEOUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
# 9 AIR																			
Part. Matter	0	0	0	-VL	-VL	0	-VL	-L	-VL	-VL	-L	-VL	-VL	-VL	-L	0	0	0	+L
Noxious Gases	0	0	0	0	0	0	-U	0	-U	0	0	0	0	0	U	0	+L	0	0
NOISE	0	0	0	-L	-L	-L	-L	-L	-L	0	-L	-L	-L	-L	-L	0	+L	0	0
# 10 AIR																			
Part. Matter	0	0	0	-VL	-VL	0	-VL	-L	-VL	-VL	-L	-VL	-VL	-VL	-L	0	0	0	+L
Noxious Gases	0	0	0	0	0	0	-U	0	-U	0	0	0	0	0	U	0	+L	0	0
NOISE	0	0	0	-L	-L	-L	-L	-L	-L	0	-L	-L	-L	-L	-L	0	+L	0	0
# 11 AIR																			
Part. Matter	0	0	0	-VL	-VL	0	-VL	-L	-VL	-VL	-L	-VL	-VL	-VL	-L	0	0	0	+L
Noxious Gases	0	0	0	0	0	0	-U	0	-U	0	0	0	0	0	U	0	+L	0	0
NOISE	0	0	0	-L	-L	-L	-L	-L	-L	0	-L	-L	-L	-L	-L	0	+L	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

AIR/NOISE

HONEY LAKE VALLEY GEOTHERMAL PROJECT (Nonelectrical)

Table 57

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
AIR																	
Move.Patt-erns	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temperature & Humidity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Part.Matter	0	0	-L	-L	-L	0	L	0	0	-L	-L	0	0	0	0	-L	+L
Noxious Gas	0	0	-VL	-VL	0	U	U	0	U	-L	0	0	0	0	0	0	0
Non Ioniz-ing Rad-iation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NOISE	0	0	0	-L	-L	-M	-M	-L	-M	0	-L	0	0	0	0	-L	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH- Very High

AIR/NOISE

HONEY LAKE VALLEY GEOTHERMAL PROJECT (Nonelectrical)

Table 57 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION: Air-borne	PRELIMINARY EXPLORATION: Off-Road (Foot)	PRELIMINARY EXPLORATION: Off-Road Vehicle	EXPLORATORY DRILLING: Road Const. & Use	EXPLORATORY DRILLING: Drill Site Dev.	EXPLORATORY DRILLING: Drill-ing	EXPLORATORY DRILLING: Well Test-ing	FIELD DEVELOPMENT: Int. Well Dev.	FIELD DEVELOPMENT: Well Vent-ing	FIELD DEVELOPMENT: Waste Dis-posal	FIELD DEVELOPMENT: Pipe-line Dev.	NON-ELECTRICAL PRODUCTION: Food Pro-duct Proc.	NON-ELECTRICAL PRODUCTION: Green Houses	NON-ELECTRICAL PRODUCTION: Single Cell Protein Prod.	CLOSE OUT: Aban-don Wells	CLOSE OUT: Re-move Equip. & Rehab.	CLOSE OUT: Surface Reclama-tion
# 1 AIR																	
Part.Matter	0	0	0	-VL	-VL	0	-VL	0	0	-VL	-VL	0	0	0	0	-VL	+L
Nox. Gases	0	0	0	0	0	0	-U	0	U	-VL	0	0	0	0	0	0	0
NOISE	0	0	0	-VL	-VL	-VL	-VL	-VL	-VL	0	-VL	0	0	0	0	-VL	0
#2 AIR																	
Part.Matter	0	0	0	-VL	-VL	0	-VL	0	0	-VL	-VL	0	0	0	0	-VL	+L
Nox. Gases	0	0	0	0	0	0	-U	0	U	-VL	0	0	0	0	0	0	0
NOISE	0	0	0	-VL	-VL	-L	-L	-VL	-L	0	-VL	0	0	0	0	-VL	0
# 3 AIR																	
Part.Matter	0	0	0	-VL	-VL	0	-VL	-VL	-VL	-VL	-VL	0	0	0	0	-VL	+VL
Nox. Gases	0	0	0	0	0	0	-U	0	U	-VL	0	0	0	0	0	0	0
NOISE	0	0	0	-VL	-VL	-L	-L	-VL	-L	0	-VL	0	0	0	0	-VL	0
# 4 AIR																	
Part.Matter	0	0	0	-VL	-VL	0	-VL	-VL	-VL	-VL	-VL	0	0	0	0	-VL	+VL
Nox. Gases	0	0	0	0	0	0	-U	0	U	-VL	0	0	0	0	0	0	0
NOISE	0	0	0	-VL	-VL	-L	-L	-VL	-L	0	-VL	0	0	0	0	-VL	0
# 5 AIR																	
Part. Matt-er	0	0	0	-VL	-VL	0	-VL	-VL	-VL	-VL	-VL	0	0	0	0	-VL	+VL
Nox. Gases	0	0	0	0	0	0	-U	0	U	-VL	0	0	0	0	0	0	0
NOISE	0	0	0	-VL	-VL	-L	-L	-VL	-L	0	-VL	0	0	0	0	-VL	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

AIR/NOISE

HONEY LAKE VALLEY GEOTHERMAL PROJECT (Nonelectrical)

Table 57 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION Air-borne	Off-Road (Foot)	Off-Road Vehicle	EXPLORATORY DRILLING Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	FIELD DEVELOPMENT Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	NON-ELECTRICAL PRODUCTION Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	CLOSE OUT Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
# 6 AIR																	
Part. Matter	0	0	0	-VL	-VL	0	-VL	-VL	-VL	-VL	-VL	0	0	0	0	-VL	+VL
Nox. Gases	0	0	0	0	0	0	-U	0	-U	-VL	0	0	0	0	0	0	0
NOISE	0	0	0	-VL	-VL	-L	-L	-VL	-L	0	-VL	0	0	0	0	-VL	0
# 7 AIR																	
Part.Matter	0	0	0	-VL	-VL	0	-VL	-VL	-VL	-VL	-VL	0	0	0	0	-VL	+VL
Nox. Gases	0	0	0	0	0	0	-U	0	U	-VL	0	0	0	0	0	0	0
NOISE	0	0	0	-VL	-VL	-L	-L	-VL	-L	0	-VL	0	0	0	0	-VL	0
# 8 AIR																	
Part.Matter	0	0	0	-VL	-VL	0	-VL	-VL	-VL	-VL	-VL	0	0	0	0	-VL	+VL
Nox. Gases	0	0	0	0	0	0	-U	0	U	-VL	0	0	0	0	0	0	0
NOISE	0	0	0	-VL	-VL	-VL	-VL	-VL	-VL	0	-VL	0	0	0	0	-VL	0
# 9 AIR																	
Part.Matter	0	0	0	-VL	-VL	0	-VL	-VL	-VL	-VL	-VL	0	0	0	0	-VL	+VL
Nox. Gases	0	0	0	0	0	0	-U	0	U	-VL	0	0	0	0	0	0	0
NOISE	0	0	0	-VL	-VL	-VL	-VL	-VL	-VL	0	-VL	0	0	0	0	-VL	0
#10 AIR																	
Part.Matter	0	0	0	-VL	-VL	0	-VL	-VL	-VL	-VL	-VL	0	0	0	0	-VL	+VL
Nox. Gases	0	0	0	0	0	0	-U	0	U	-VL	0	0	0	0	0	0	0
NOISE	0	0	0	-VL	-VL	-VL	-VL	-VL	-VL	0	-VL	0	0	0	0	-VL	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

AIR/NOISE

HONEY LAKE VALLEY GEOTHERMAL PROJECT, (Nonelectrical)

Table 57 (Continued)

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
#11 AIR																	
Part. Matter	0	0	0	-VL	-VL	0	-VL	-VL	-VL	-VL	-VL	0	0	0	0	-VL	+VL
Nox. Gases	0	0	0	0	0	0	-U	0	U	-VL	0	0	0	0	0	0	0
NOISE	0	0	0	-VL	-VL	-VL	-VL	-VL	-VL	0	-VL	0	0	0	0	-VL	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - VEGETATION (Electrical)

Table 58

Potential Leasing Unit	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-ling Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main	Aban-don Wells	Remove Equip. & Rehab.	Surface Reclaim
Lease # 1																			
1	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-M	-L	-L	-L	-L	+L	-L	+H
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	0	-L	+M
Lease # 2																			
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	0	-L	+M
3	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-L	0	-L	+M
Lease # 3																			
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	0	-L	+M
5	0	0	-L	-M	-L	-L	-L	-L	-L	-M	-H	-H	-M	-M	-M	-L	0	-L	+L
Lease # 4																			
3	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-L	0	-L	+M
Lease # 5																			
1	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	+L	-L	+H
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	0	-L	+M
4	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-L	-L	-L	-L	-L	+L	-L	+M
Lease # 6																			
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	0	-L	+M
3	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	0	-L	+M
4	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-M	-L	-L	-L	-L	+L	-L	+M
5	0	0	-L	-M	-L	-L	-L	-L	-L	-M	-H	-H	-M	-M	-M	-M	0	-L	+L
Lease # 7																			
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	0	-L	+M
3	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	0	-L	+M
4	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-M	-L	-L	-L	-L	+L	-L	+M
5	0	0	-L	-M	-L	-L	-L	-L	-L	-M	-H	-H	-M	-M	-M	-L	0	-L	+L
Lease # 8																			
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	0	-L	+M
3	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	0	-L	+M
4	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-M	-L	-L	-L	-L	+L	-L	+M

HONEY LAKE VALLEY GEOTHERMAL PROJECT - **VEGETATION** (Electrical)

Table 58 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION: Air-borne	Off-Road (Foot)	Off-Road Vehicle	EXPLORATORY DRILLING: Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	FIELD DEVELOPMENT: Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-ling Dev.	Power Plant Const.	PRODUCTION OF ENERGY: Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main	CLOSE OUT: Aban-don Wells	Remove Equip. & Rehab.	Surface Reclam
Lease # 9																			
2	0	0	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	-M	0	-L	+M
3	0	0	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	-M	0	-L	+M
Lease #10																			
2	0	0	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	-M	0	-L	+M
4	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-M	-L	-L	-L	-L	+L	-L	+M
7	0	0	-M	-M	-L	-L	-M	-H	U	-M	-H	-H	-H	-M	-M	-M	+M	-H	+H
Lease #11																			
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-M	0	-L	+M
4	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-M	-L	-L	-L	-L	+L	-L	+M

LEGEND

Impact Ratings: U - Unknown, 0 - None, L - Low, M - Moderate
H - High, VH - Very High

1 - Grass (Burned Over Area)
2 - Sagebrush
2a- Low Sagebrush
3 - Greasewood
4 - Saltgrass
5 - Salt Desert Shrub
6 - Bitterbrush
7 - Cropland - Irrigated

HONEY LAKE VALLEY GEOTHERMAL PROJECT - VEGETATION (Nonelectrical)

Table 59

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION (5-21 Acres)			CLOSE OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses 7 Ac.	Single Cell Protein Prod. 20 Ac.	Aban-don Wells	Remove Equip. & Rehab.	Surface Reclaim
Lease # 1																	
1	0	0	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	-L	-L	0	+L	+H
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
Lease # 2																	
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
3	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
Lease # 3																	
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
5	0	0	-L	-M	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+L
Lease # 4																	
3	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
Lease # 5																	
1	0	0	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	-L	-L	0	+L	+M
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
4	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
Lease # 6																	
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
3	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
4	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
5	0	0	-L	-M	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+L
Lease # 7																	
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
3	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
4	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
5	0	0	-L	-M	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+L

HONEY LAKE VALLEY GEOTHERMAL PROJECT - VEGETATION (Nonelectrical)

Table 59 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION (5-21 Acres)			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses 7 Ac.	Single Cell Protein Prod. 20 Ac.	Aban-don Wells	Remove Equip. & Rehab.	Surface Reclaim
Lease # 8																	
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
3	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
4	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
Lease # 9																	
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
3	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
Lease #10																	
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
4	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
7	0	0	-M	-H	-L	-L	-M	-M	U	-M	-M	-M	-M	-M	U	-M	+H
Lease #11																	
2	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
4	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M

LEGEND

Impact Ratings: U - Unknown, 0 - None, L - Low,
M - Moderate, H - High, VH - Very High

1 - Grass (Burned Over Area)
2 - Sagebrush
2a- Low Sagebrush
3 - Greasewood
4 - Saltgrass
5 - Salt Desert Shrub
6 - Bitterbrush
7 - Cropland - Irrigated

HONEY LAKE VALLEY GEOTHERMAL PROJECT - LIVESTOCK - Cattle Only (Electrical) Table 60

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-ling Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main	Aban-don Wells	Remove Equip. & Rehab.	Surface Reclaim
Forage and Water Supply:																			
Lease # 1	0	0	0	-L	-L	0	0	-L	0	U	-L	-L	-L	-L	0	0	0	0	+L
Lease # 2	0	0	0	-L	-L	0	0	-L	0	U	-L	-L	-L	-L	0	0	0	0	+L
Lease # 3	0	0	0	-L	-L	0	0	-L	0	U	-L	-L	-L	-L	0	0	0	0	+L
Lease # 4	0	0	0	-L	-L	0	0	-L	0	U	-L	-L	-L	-L	0	0	0	0	+L
Lease # 5	0	0	0	-L	-L	0	0	-L	0	U	-L	-L	-L	-L	0	0	0	0	+L
Lease # 6	0	0	0	-L	-L	0	0	-L	0	U	-L	-L	-L	-L	0	0	0	0	+L
Lease # 7	0	0	0	-L	-L	0	0	-L	0	U	-L	-L	-L	-L	0	0	0	0	+L
Lease # 8	0	0	0	-L	-L	0	0	-L	0	U	-L	-L	-L	-L	0	0	0	0	+L
Lease # 9	0	0	0	-L	-L	0	0	-L	0	U	-L	-L	-L	-L	0	0	0	0	+L
Lease #10	0	0	-L	-M	-M	0	0	-L	U	U	-M	-M	-M	-M	0	0	0	0	+M
Lease #11	0	0	0	-L	-L	0	0	-L	0	U	0	0	-L	-L	0	0	0	0	+L
Animal Activities:	0	0	-L	-L	-L	0	0	0	U	U	-L	-L	-L	-L	-L	0	0	0	0

LEGEND

Impact Ratings: U - Unknown, 0 - None, L - Low, M - Moderate, H - High, VH - Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - LIVESTOCK - Cattle Only (Nonelectrical) Table 61

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Well	Remove Equip. & Rehab.	Surface Reclaim
Forage & Water Supply:																	
Lease # 1	0	0	0	-L	-L	0	0	-L	0	U	0	-L	-L	-L	0	0	+L
Lease # 2	0	0	0	-L	-L	0	0	-L	0	U	0	-L	-L	-L	0	0	+L
Lease # 3	0	0	0	-L	-L	0	0	-L	0	U	0	-L	-L	-L	0	0	+L
Lease # 4	0	0	0	-L	-L	0	0	-L	0	U	0	-L	-L	-L	0	0	+L
Lease # 5	0	0	0	-L	-L	0	0	-L	0	U	0	-L	-L	-L	0	0	+L
Lease # 6	0	0	0	-L	-L	0	0	-L	0	U	0	-L	-L	-L	0	0	+L
Lease # 7	0	0	0	-L	-L	0	0	-L	0	U	0	-L	-L	-L	0	0	+L
Lease # 8	0	0	0	-L	-L	0	0	-L	0	U	0	-L	-L	-L	0	0	+L
Lease # 9	0	0	0	-L	-L	0	0	-L	0	U	0	-L	-L	-L	0	0	+L
Lease #10	0	0	-L	-M	-M	0	0	-M	0	U	-L	-M	-M	-M	0	-L	+M
Lease #11	0	0	0	-L	-L	0	0	-L	0	U	0	-L	-L	-L	0	0	+L
Animal Activities:	0	0	-L	-L	-L	0	0	-L	0	U	0	-L	-L	-L	0	0	+L

LEGEND

Impact Ratings: U - Unknown, 0 - None, L - Low, M - Moderate, H - High, VH - Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Electrical)

Table 62

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
Lease Site # 1																			
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Year-round Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptors Nesting Areas & Buffer Zone	L	L	L	M	VH	VH	VH	H	VH	VH	VH	VH	VH	VH	VH	VH	M	M	M
Endangered & Threatened Species	0	0	0	0	0	0	C	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lease Site # 2																			
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - **WILDLIFE** (Electrical)

Table 62 (Continued)

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
Bighorn Sheep Proposed Range	L	L	L	H	H	H	H		H	H	H	VH	H	H	H	H	L	L	L
Raptors Nest-ing Areas & Buffer Zones	H	H	H	VH	VH	VH	VH	VH	VH	VH	VH	VH	VH	VH	VH	VH	M	M	M
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lease Site # 3																			
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	L	L	L	M	M	M	M	M	M	M	M	H	M	M	M	M	L	L	L
Raptors Nest-ing Areas & Buffer Zones	L	L	L	L	L	L	L	L	L	L	L	M	L	M	M	L	L	L	L

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Electrical)

Table 62 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
Endandered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lease Site # 4																			
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptors Nesting Areas & Buffer Zones	L	L	L	M	M	M	M	M	M	M	M	M	M	M	M	M	L	L	L
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	L	L	L	M	H	H	H	H	VH	VH	H	H	H	M	H	M	L	L	L

Impact Ratings: U-Unknown, O-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Electrical)

Table 62 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surfac. Reclam-ation
Lease Site # 5																			
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptors Nesting Areas & Buffer Zones	L	L	L	H	H	H	H	H	H	H	H	H	H	VH	H	H	L	L	L
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lease Site # 6																			
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Electrical)
SHORT TERM

Table 62 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surfac. Reclam-ation
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptors Nest-ing Areas & Buffer Zones	L	L	L	M	M	H	H	H	H	H	H	VH	H	H	H	H	L	L	L
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lease Site # 7																			
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	L	L	L	H	H	H	H	H	H	H	H	VH	H	H	VH	H	L	L	L
Raptors Nest-ing Areas & Buffer Zones	M	M	M	VH	VH	VH	VH	VH	VH	H	VH	VH	VH	VH	VH	VH	L	L	L

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Electrical)

Table 62 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION: Air-borne	Off-Road (Foot)	Off-Road Vehicle	EXPLORATORY DRILLING: Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	FIELD DEVELOPMENT: Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	PRODUCTION OF ENERGY: Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	CLOSE OUT: Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas				L	M	M	H	M	H	H	M	VH	M	L	H	M	L	L	L
Lease Site # 8																			
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptors Nesting Areas & Buffer Zones	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	L	L	L	M	M	H	H	H	H	VH	M	M	M	M	M	M	L	L	L

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Electrical)

Table 62 (Continued)

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE-OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Recla-mation
Lease Site # 9																			
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptors Nesting Areas & Buffer Zones	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Endangered & Threatened Species	0	0	0	L	M	M	M	M	M	M	L	M	M	L	M	L	L	L	L
Waterfowl Production Areas	L	L	L	M	M	H	VH	H	VH	VH	H	VH	H	M	VH	M	L	L	L
Lease Site #10																			
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Electrical)

Table 62 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION: Air-borne	Off-Road (Foot)	Off-Road Vehicle	EXPLORATORY DRILLING: Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	FIELD DEVELOPMENT: Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	PRODUCTION OF ENERGY: Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	CLOSE OUT: Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptors Nesting Areas & Buffer Zones	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Endangered & Threatened Species	0	0	0	L	M	M	M	M	M	M	L	M	M	L	M	L	L	L	L
Waterfowl Production Area & Staging Areas	L	L	L	M	H	H	VH	H	VH	VH	M	M	H	M	M	M	L	L	L
Lease Site #11																			
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Electrical)

Table 62 (Continued)

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
Raptors Nest-ing Areas & Buffer Zones	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - **WILDLIFE** (Nonelectrical)

Table 63

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
Lease Site # 1																	
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptor Nesting Area and Buffer Zone	L	L	M	VH	VH	VH	VH	VH	VH	VH	VH	VH	VH	VH	M	M	M
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH- Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - **WILDLIFE** (Nonelectrical)

Table 63 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
Lease Site # 2																	
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	L	L	L	H	H	H	H	H	H	H	H	VH	VH	VH	M	M	M
Raptor Nest-ing Site & Buffer Zone	M	M	M	VH	VH	VH	VH	VH	VH	VH	VH	VH	VH	VH	M	M	M
Endangered & Threatened Species		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH- Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Nonelectrical) Table 63 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION: Air-borne	Off-Road (Foot)	Off-Road Vehicle	EXPLORATORY DRILLING: Road Const. & Use	Drill Site Dev.	Drilling	Well Testing	FIELD DEVELOPMENT: Int. Well Dev.	Well Venting	Waste Disposal	Pipeline Dev.	NON-ELECTRICAL PRODUCTION: Food Product Proc.	Green Houses	Single Cell Protein Prod.	[illegible]: Abandon Wells	Remove Facil. & Rehab.	[illegible]
Lease Site # 3																	
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	L	L	L	M	M	M	M	M	M	M	M	M	M	M	L	L	L
Raptors	L	L	L	H	H	H	H	H	H	H	H	H	H	H	L	L	L
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lease Site # 4																	
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Nonelectrical)

Table # 63 (Continued

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-Borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptors Nesting Area & Buffer Zone	L	L	L	M	M	M	M	M	M	M	M	M	M	M	M	M	M
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	L	L	L	M	H	H	VH	H	VH	VH	H	M	M	M	L	L	L
Lease Site # 5																	
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, O-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Nonelectrical) Table # 63 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	[illegible]
Raptors Nesting Area & Buffer Zone	L	L	L	H	H	H	H	H	H	H	H	H	H	H	L	L	L
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lease Site # 6																	
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptors Nesting Area & Buffer Zone	L	L	L	H	H	H	H	H	H	H	H	H	H	H	L	L	L

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Nonelectrical)

Tab = 63 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lease Site # 7																	
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	L	L	L	H	H	H	H	H	H	H	H	VH	VH	VH	L	L	L
Raptors Nesting Area & Buffer Zone	M	M	M	VH	VH	VH	VH	VH	VH	VH	VH	VH	VH	VH	L	L	L
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, O-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Nonelectrical) Tab = 63 (Continued)

Potential Leasing Unit	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Constr. & Use	Drill Site Dev.	Drilling	Well Testing	Int. Well Dev.	Well Venting	Waste Disposal	Pipeline Dev.	Food Product Proc.	Green Houses	Single Cell Protein Prod.	Abandon Wells	Remove Equip. & Rehab.	Surface Reclamation
Waterfowl Production Areas	L	L	L	M	H	H	H	H	VH	VH	H	H	H	H	L	L	L
Lease Site # 8																	
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptor Nesting Area & Buffer Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	L	L	L	M	M	H	H	H	H	VH	H	M	M	M	L	L	L

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Nonelectrical)

Table 63 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION: Air-borne	Off-Road (Foot)	Off-Road Vehicle	EXPLORATORY DRILLING: Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	FIELD DEVELOPMENT: Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	NON-ELECTRICAL PRODUCTION: Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	CLOSE OUT: Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
Lease Site # 9																	
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptors Nesting Area & Buffer Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Endangered & Threatened Species	0	0	0	L	M	M	M	M	M	M	L	L	L	L	L	L	L
Waterfowl Production Areas	L	L	L	L	M	H	H	H	H	VH	M	L	L	L	L	L	L
Lease Site #10																	
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - **WILDLIFE** (Nonelectrical)

Table 63 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION: Air-borne	Off-Road (Foot)	Off-Road Vehicle	EXPLORATORY DRILLING: Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	FIELD DEVELOPMENT: Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	NON-ELECTRICAL PRODUCTION: Food Product Proc.	Green Houses	Single Cell Protein Prod.	CLOSE OUT: Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptors Nesting Area & Buffer Zone	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Endangered & Threatened Species	0	0	0	L	M	M	M	M	M	M	L	L	L	L	L	L	L
Waterfowl Production Areas	L	L	L	L	H	H	H	H	H	VH	L	L	L	L	L	L	L
Lease Site #11																	
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - WILDLIFE (Nonelectrical)

Table 63 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
Bighorn Sheep Proposed Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Endangered & Threatened Species	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Waterfowl Production Areas	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - AESTHETICS/RECREATION (Electrical) Table 64 Page 1 of 5

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
UNIT 1																			
Aesthetics																			
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-H	-H	-H	-H	-H	-H	0	-H	+L
VRM Class III	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-H	-H	-M	-H	-H	-M	0	-M	+L
Recreation																			
Motorcycle Events and ORV Riding	0	0	+L	-L	-L	-VL	0	-L	0	-L	-M	-M	-L	-L	-L	-L	0	-L	+L
Hunting	-VL	-VL	-L	-L	-M	-M	-L	-M	-L	-L	-M	-M	-M	-M	-L	-L	-VL	-M	+M
UNIT 2																			
Aesthetics																			
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-H	-H	-H	-H	-H	-H	0	-H	+L
VRM Class III	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-H	-H	-M	-H	-H	-M	0	-M	+L
Recreation																			
Motorcycle Events and ORV Riding	0	0	+L	-L	-L	-VL	0	-L	0	-L	-M	-M	-L	-L	-L	-L	0	-L	+L
Roadless Study Area	-VL	-L	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-L	-H	-M
Hunting	-VL	-VL	-L	-L	-M	-M	-L	-M	-L	-L	-M	-M	-M	-M	-L	-L	-VL	-M	+M

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - AESTHETICS/RECREATION (Electrical)

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
UNIT 3																			
Aesthetics																			
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-H	-H	-H	-H	-H	-H	0	-H	+L
VRM Class III	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-H	-H	-M	-H	-H	-M	0	-M	+L
Recreation																			
Roadless Study Area	-VL	-L	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-L	-H	-M
Hunting	-VL	-VL	-L	-L	-M	-M	-L	-M	-L	-L	-M	-M	-M	-M	-L	-L	-VL	-M	+M
UNIT 4																			
Aesthetics																			
VRM Class III	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-H	-H	-M	-H	-H	-M	0	-M	+L
Recreation																			
Motorcycle Events and ORV Riding	0	0	+L	-L	-L	-VL	0	-L	0	-L	-M	-M	-L	-L	-L	-L	0	-L	+L
UNIT 5																			
Aesthetics																			
VRM Class III	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-H	-H	-M	-H	-H	-M	0	-M	+L
VRM Class IV	0	0	-L	-L	-L	-L	-L	-M	-L	-L	-M	-M	-M	-H	-H	-L	0	-M	+M
Recreation																			
Motorcycle Events and ORV Riding	0	0	+L	-L	-L	-VL	0	-L	0	-L	-M	-M	-L	-L	-L	-L	0	-L	+L
Hunting	-VL	-VL	-L	-L	-M	-M	-L	-M	-L	-L	-M	-M	-M	-M	-L	-L	-VL	-M	+M
Camping	0	-VL	-L	-L	-L	-L	-VL	-L	0	-L	-M	-M	-L	-M	-L	-L	0	-M	+L

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - AESTHETICS/RECREATION (Electrical) Table 64 (Con't) Page 3 of 5

Potential Leasing Unit	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
Rock Collecting																			
and Geologic																			
Sightseeing	0	-VL	+VL	-L	-L	0	0	-L	0	-L	-M	-M	-L	-L	-L	-L	0	-L	+L
UNIT 6																			
Aesthetics																			
VRM Class III	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-H	-H	-M	-H	-H	-M	0	-M	+L
Recreation																			
Motorcycle																			
Events and																			
ORV Riding	0	0	+L	-L	-L	-VL	0	-L	0	-L	-M	-M	-L	-L	-L	-L	0	-L	+L
Hunting	-VL	-VL	-L	-L	-M	-M	-L	-M	-L	-L	-M	-M	-M	-M	-L	-L	-VL	-M	+M
Roadless St.Area	-VL	-L	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-L	-H	-M
UNIT 7																			
Aesthetics																			
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-H	-H	-H	-H	-H	-H	0	-H	+L
VRM Class III	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-H	-H	-M	-H	-H	-M	0	-M	+L
Recreation																			
Motorcycle																			
Events and																			
ORV Riding	0	0	+L	-L	-L	-VL	0	-L	0	-L	-M	-M	-L	-L	-L	-L	0	-L	+L
Roadless																			
Study																			
Area	-VL	-L	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-L	-H	-M
Hunting	-VL	-VL	-L	-L	-M	-M	-L	-M	-L	-L	-M	-M	-M	-M	-L	-L	-VL	-M	+M
Archaeological																			
Sightseeing	0	0	+VL	-VL	-L	-L	0	-L	0	-L	-L	-L	-L	-L	-L	-L	0	-L	+L

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - AESTHETICS/RECREATION (Electrical) Table 64 (Con't) Page 4 of 5

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
UNIT 8																			
Aesthetics																			
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-H	-H	-H	-H	-H	-H	0	-H	+L
VRM Class IV	0	0	-L	-L	-L	-L	-L	-M	-L	-L	-M	-M	-M	-H	-H	-L	0	-M	+M
Recreation																			
Artifact																			
Hunting	0	-VL	+VL	-L	-L	0	0	-L	0	-L	-M	-M	-L	-VL	-L	-L	0	-L	+L
UNIT 9																			
Aesthetics																			
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-H	-H	-H	-H	-H	-H	0	-H	+L
VRM Class IV	0	0	-L	-L	-L	-L	-L	-M	-L	-L	-M	-M	-M	-H	-H	-L	0	-M	+M
Recreation																			
Artifact																			
Hunting	0	-VL	+VL	-L	-L	0	0	-L	0	-L	-M	-M	-L	-VL	-L	-L	0	-L	+L
UNIT 10																			
Aesthetics																			
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-H	-H	-H	-H	-H	-H	0	-H	+L
VRM Class IV	0	0	-L	-L	-L	-L	-L	-M	-L	-L	-M	-M	-M	-H	-H	-L	0	-M	+M
Recreation																			
Artifact																			
Hunting	0	-VL	+VL	-L	-L	0	0	-L	0	-L	-M	-M	-L	-VL	-L	-L	0	-L	+L
UNIT 11																			
Aesthetics																			
VRM Class IV	0	0	-L	-L	-L	-L	-L	-M	-L	-L	-M	-M	-M	-H	-H	-L	0	-M	+M

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - AESTHETICS/RECREATION (Electrical) Table 64 (Con't) Page 5 of 5

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Potential Leasing Unit / Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
Recreation																			
Artifact																			
Hunting	0	-VL	+VL	-L	-L	0	0	-L	0	-L	-M	-M	-L	-VL	-L	-L	0	-L	+L

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - AESTHETICS/RECREATION (Nonelectrical) Table 65

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
UNIT 1																	
Aesthetics																	
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-M	-M	-M	-H	0	-H	+L
VRM ClassIII	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-M	-M	-M	-M	0	-M	+L
Recreation																	
Motorcycle Events & ORV Riding	0	0	+L	-L	-L	-VL	0	-L	0	-L	-L	-L	-L	-M	0	-L	+L
Hunting	-VL	-VL	-L	-L	-M	-M	-L	-M	-L	-L	-L	-L	-L	-M	-VL	-M	+M
UNIT 2																	
Aesthetics																	
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-M	-M	-M	-H	0	-H	+L
VRM ClassIII	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-M	-M	-M	-M	0	-M	+L
Recreation																	
Motorcycle Events & ORV Riding	0	0	+L	-L	-L	-VL	0	-L	0	-L	-L	-L	-L	-M	0	-L	+L
Roadless Study Area	-VL	-L	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-L	-H	-M
Hunting	-VL	-VL	-L	-L	-M	-M	-L	-M	-L	-L	-L	-L	-L	-M	-VL	-M	+M
UNIT 3																	
Aesthetics																	
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-M	-M	-M	-H	0	-H	+L

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH- Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT – AESTHETICS/RECREATION (Nonelectrical) Table 65 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
VRM ClassIII	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-M	-M	-M	-M	0	-M	+L
Recreation																	
Roadless Study Area	-VL	-L	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-L	-H	-M
Hunting	-VL	-VL	-L	-L	-M	-M	-L	-M	-L	-L	-L	-L	-L	-M	-VL	-M	+M
UNIT 4																	
Aesthetics																	
VRM ClassIII	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-M	-M	-M	-M	0	-M	+L
Recreation																	
Motorcycle Events & ORV Riding	0	0	+L	-L	-L	-VL	0	-L	0	-L	-L	-L	-L	-M	0	-L	+L
UNIT 5																	
Aesthetics																	
VRM ClassIII	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-M	-M	-M	-M	0	-M	+L
VRM Class IV	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-M	0	-L	+M
Recreation																	
Motorcycle Events & ORV Riding	0	0	+L	-L	-L	-VL	0	-L	0	-L	-L	-L	-L	-M	0	-L	+L
Hunting	-VL	-VL	-L	-L	-M	-M	-L	-M	-L	-L	-L	-L	-L	-M	-VL	-M	+M
Camping	0	-VL	-L	-L	-L	-L	-VL	-L	0	-L	-L	-L	-L	-M	0	-M	+L

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH- Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT -- AESTHETICS/RECREATION (Nonelectrical) Table 65 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
Rock Collecting & Geologic Sightseeing	0	-VL	+VL	-L	-L	0	0	-L	0	-L	-L	-L	-L	-L	0	-L	+L
UNIT 6																	
Aesthetics																	
VRM Class III	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-M	-M	-M	-M	0	-M	+L
Recreation																	
Motorcycle Events & ORV Riding	0	0	+L	-L	-L	-VL	0	-L	0	-L	-L	-L	-L	-M	0	-L	+L
Hunting	-VL	-VL	-L	-L	-M	-M	-L	-M	-L	-L	-L	-L	-L	-M	-VL	-M	+M
Roadless Area	-VL	-L	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-L	-H	-M
UNIT 7																	
Aesthetics																	
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-M	-M	-M	-H	0	-H	+L
VRM Class III	0	0	-L	-M	-M	-L	-L	-M	-L	-M	-M	-M	-M	-M	0	-M	+L
Recreation																	
Motorcycle Events & ORV Riding	0	0	+L	-L	-L	-VL	0	-L	0	-L	-L	-L	-L	-M	0	-L	+L
Roadless Study Area	-VL	-L	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-H	-L	-H	-M
Hunting	-VL	-VL	-L	-L	-M	-M	-L	-M	-L	-L	-L	-L	-L	-M	-VL	-M	+M

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH- Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT - AESTHETICS/RECREATION (Nonelectrical) Table 65 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
Archaeolog-ical Sight-seeing	0	0	+VL	-VL	-L	-L	0	-L	0	-L	-L	-L	-L	-L	0	-L	+L
UNIT 8																	
Aesthetics																	
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-M	-M	-M	-H	0	-H	+L
VRM Class IV	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-M	0	-L	+M
Recreation Artifact Hunting	0	-VL	+VL	-L	-L	0	0	-L	0	-L	-L	-L	-L	-L	0	-L	+L
UNIT 9																	
Aesthetics																	
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-M	-M	-M	-H	0	-H	+L
VRM Class IV	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-M	0	-L	+M
Recreation Artifact Hunting	0	-VL	+VL	-L	-L	0	0	-L	0	-L	-L	-L	-L	-L	0	-L	+L
UNIT 10																	
Aesthetics																	
VRM Class II	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-M	-M	-M	-H	0	-H	+L
VRM Class IV	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-M	0	-L	+M

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT – AESTHETICS/RECREATION (Nonelectrical)

Table 65 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
Recreation																	
Artifact																	
Hunting	0	-VL	+VL	-L	-L	0	0	-L	0	-L	-L	-L	-L	-L	0	-L	+L
UNIT 11																	
Aesthetics																	
VRM ClassIV	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-M	0	-L	+M
Recreation																	
Artifact																	
Hunting	0	-VL	+VL	-L	-L	0	0	-L	0	-L	-L	-L	-L	-L	0	-L	+L

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH- Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT

(Electrical)
Leasing Unit Matrix
Wendel-Amedee Area
Archaeological Resources

Table 66

Potential Leasing Unit Components	PRELIMINARY EXPLORATION: Air-borne	PRELIMINARY EXPLORATION: Off-Road (Foot)	PRELIMINARY EXPLORATION: Off-Road Vehicle	EXPLORATORY DRILLING: Road Const. & Use	EXPLORATORY DRILLING: Drill Site Dev.	EXPLORATORY DRILLING: Drill-ing	EXPLORATORY DRILLING: Well Test-ing	FIELD DEVELOPMENT: Int. Well Dev.	FIELD DEVELOPMENT: Well Vent-ing	FIELD DEVELOPMENT: Waste Dis-posal	FIELD DEVELOPMENT: Pipe-line Dev.	FIELD DEVELOPMENT: Power Plant Const.	PRODUCTION OF ENERGY: Add'l Well Dev.	PRODUCTION OF ENERGY: Const. Power Lines	PRODUCTION OF ENERGY: Prod. & Use	PRODUCTION OF ENERGY: Main-ten-ance	CLOSE OUT: Aban-don Wells	CLOSE OUT: Re-move Equip. & Rehab.	CLOSE OUT: Surface Reclam-ation
Unit #1																			
440 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*H*	*H*	*L*	*L*	*0*	*0*	*0*
320 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Unit #2																			
40 Acres	*0*	*L*	*L*	*L*	*L*	*L*	*0*	*M*	*U*	*L*	*L*	*M*	*M*	*L*	*L*	*L*	*0*	*0*	*0*
1080 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Unit #3																			
40 Acres	*0*	*0*	*M*	*M*	*M*	*M*	*L*	*H*	*U*	*H*	*M*	*VH*	*H*	*M*	*L*	*L*	*0*	*0*	*0*
641 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Unit #4																			
40 Acres	*0*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*U*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*0*	*0*	*0*
280 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*H*	*H*	*L*	*L*	*0*	*0*	*0*
Unit #5																			
400 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*H*	*H*	*L*	*L*	*0*	*0*	*0*
40 Acres	*0*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*U*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*0*	*0*	*0*
565 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Unit #6																			
120 Acres	*0*	*0*	*M*	*M*	*M*	*M*	*L*	*H*	*U*	*H*	*M*	*VH*	*H*	*M*	*L*	*L*	*0*	*0*	*0*
40 Acres	*0*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*U*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*0*	*0*	*0*
1160 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Unit #7																			
1154 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*H*	*H*	*L*	*L*	*0*	*0*	*0*
520 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT

(Electrical)
Leasing Unit Matrix
Island Area
Archaeological Resources

Table 66 (Continued)

Potential Leasing Unit	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
Unit #8																			
480 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
774 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*H*	*H*	*L*	*L*	*0*	*0*	*0*
Unit #9																			
480 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
576 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*H*	*H*	*L*	*L*	*0*	*0*	*0*
Unit #10																			
Unsurveyed	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*
Unit #11																			
120 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
683 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*H*	*H*	*L*	*L*	*0*	*0*	*0*

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT

(Nonelectrical)
Leasing Unit Matrix
Wendel-Amedee Area
Archaeological Resources

Table 67

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
Unit #1																	
440 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*VH*	*VH*	*0*	*0*	*0*
320 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Unit #2																	
40 Acres	*0*	*L*	*L*	*L*	*L*	*L*	*0*	*M*	*U*	*L*	*L*	*M*	*M*	*M*	*0*	*0*	*0*
1080 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Unit #3																	
40 Acres	*0*	*0*	*M*	*M*	*M*	*M*	*L*	*H*	*U*	*H*	*M*	*VH*	*VH*	*VH*	*0*	*0*	*0*
641 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Unit #4																	
40 Acres	*0*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*U*	*L*	*L*	*L*	*L*	*L*	*0*	*0*	*0*
280 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*VH*	*VH*	*0*	*0*	*0*
Unit #5																	
400 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*VH*	*VH*	*0*	*0*	*0*
40 Acres	*0*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*U*	*L*	*L*	*L*	*L*	*L*	*0*	*0*	*0*
565 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Unit #6																	
120 Acres	*0*	*0*	*M*	*M*	*M*	*M*	*L*	*H*	*U*	*H*	*M*	*VH*	*VH*	*VH*	*0*	*0*	*0*
40 Acres	*0*	*L*	*L*	*L*	*L*	*L*	*L*	*L*	*U*	*L*	*L*	*L*	*L*	*L*	*0*	*0*	*0*
1160 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Unit #7																	
1154 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*VH*	*VH*	*0*	*0*	*0*
520 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*

Impact Ratings: U-Unknown, O-None, L-Low, M-Moderate, H-High, VH- Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT

(Nonelectrical)
Leasing Unit Matrix
Island Area
Archaeological Resources

Table 67 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
Unit #8																	
480 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*U*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
774 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*VH*	*VH*	*0*	*0*	*0*
Unit #9																	
480 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
576 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*VH*	*VH*	*0*	*0*	*0*
Unit #10																	
Unsurveyed	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*	*U*
Unit #11																	
120 Acres	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
683 Acres	*0*	*L*	*M*	*H*	*H*	*H*	*M*	*H*	*U*	*H*	*H*	*VH*	*VH*	*VH*	*0*	*0*	*0*

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH- Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Environmental Unit Impact Matrix
(Electrical)
Archaeological Resources

Table 68

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
UNIT # 1	Wendel-Amedee Area																		
Villages (5)	0	L	M	H	H	H	M	H	U	H	H	VH	H	H	L	L	0	0	0
Camps (5)	0	L	M	H	H	H	M	H	U	H	H	VH	H	H	L	L	0	0	0
Lithic Scatters (5)	0	0	M	M	M	M	L	H	U	H	M	VH	H	M	L	L	0	0	0
UNIT # 2																			
Milling Station (1)	0	L	L	L	L	L	0	M	U	L	L	M	M	L	L	L	0	0	0
UNIT # 3																			
Lithic Scatter (1)	0	0	M	M	M	M	L	H	U	H	M	VH	H	M	L	L	0	0	0
UNIT # 4																			
Villages (2)	0	L	M	H	H	H	M	H	U	H	H	VH	H	H	L	L	0	0	0
UNIT # 5																			
Vilages (7)	0	L	M	H	H	H	M	H	U	H	H	VH	H	H	L	L	0	0	0
Lithic Scatters (3)	0	0	M	M	M	M	L	H	U	H	M	VH	H	M	L	L	0	0	0
Camps (2)	0	L	M	H	H	H	M	H	U	H	H	VH	H	M	L	L	0	0	0
UNIT # 6																			
Lithic Scatters (2)	0	0	M	M	M	M	L	H	U	H	M	VH	H	M	L	L	0	0	0
Milling Stations (1)	0	L	L	L	L	L	0	M	U	L	L	M	M	L	L	L	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Environmental Unit Impact Matrix
(Electrical)
Archaeological Resources

Table 68 (Continued)

	PRELIMINARY EXPLORATION		EXPLORATORY DRILLING					FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Potential Leasing Unit Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l Well Dev.	Const. Power Lines	Prod. & Use	Main-ten-ance	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclam-ation
UNIT # 7																			
Village (1)	0	L	M	H	H	H	M	H	U	H	H	VH	H	H	L	L	0	0	0
Camps (3)	0	L	M	H	H	H	M	H	U	H	H	VH	H	H	L	L	0	0	0
Lithic Scatter (1)	0	0	M	M	M	M	L	H	U	H	M	VH	H	M	L	L	0	0	0
Caves (5)	0	0	0	L	M	M	L	H	U	L	L	VH	H	L	L	L	0	0	0
Petroglyphs (1)	0	0	0	L	M	L	0	H	U	L	L	VH	H	L	L	L	0	0	0
Milling Stations (3)	0	L	L	L	L	L	0	M	U	L	L	M	M	L	L	L	0	0	0
UNIT # 8	Island Area																		
Camp (1)	0	L	M	H	H	H	M	H	U	H	H	VH	H	H	L	L	0	0	0
Lithic Scatters (3)	0	0	M	M	M	M	L	H	U	H	M	VH	H	M	L	L	0	0	0
Milling Station (1)	0	0	L	L	L	L	0	M	U	L	L	M	M	L	L	L	0	0	0
UNIT # 9																			
Camps (5)	0	L	M	H	H	H	M	H	U	H	H	VH	H	H	L	L	0	0	0
Lithic Scatters (3)	0	0	M	M	M	M	L	H	U	H	M	VH	H	M	L	L	0	0	0
Milling Station (1)	0	0	L	L	L	L	0	M	U	L	L	M	M	L	L	L	0	0	0
UNIT #10																			
Unsurveyed	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
UNIT #11																			
Camps (7)	0	L	M	H	H	H	M	H	U	H	H	VH	H	H	L	L	0	0	0
Lithic Scatters (9)	0	0	M	M	M	M	L	H	U	H	M	VH	H	M	L	L	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Environmental Unit Matrix
(Nonelectrical)
Archaeological Resources

Table 69

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
UNIT # 1	Wendel-Amedee Area																
Villages (5)	0	L	M	H	H	H	M	H	U	H	H	VH	VH	VH	0	0	0
Camps (5)	0	L	M	H	H	H	M	H	U	H	H	VH	VH	VH	0	0	0
Lithic Scatters (5)	0	0	M	M	M	M	L	H	U	H	M	VH	VH	VH	0	0	0
UNIT # 2																	
Milling Station (1)	0	L	L	L	L	L	0	M	U	L	L	M	M	M	0	0	0
UNIT # 3																	
Lithic Scatter (1)	0	0	M	M	M	M	L	H	U	H	M	VH	VH	VH	0	0	0
UNIT # 4																	
Villages (2)	0	L	M	H	H	H	M	H	U	H	H	VH	VH	VH	0	0	0
UNIT # 5																	
Villages (7)	0	L	M	H	H	H	M	H	U	H	H	VH	VH	VH	0	0	0
Camps (2)	0	L	M	H	H	H	M	H	U	H	H	VH	VH	VH	0	0	0
Lithic Scatters (3)	0	0	M	M	M	M	L	H	U	H	M	VH	VH	VH	0	0	0
UNIT # 6																	
Lithic Scatters (2)	0	0	M	M	M	M	L	H	U	H	M	VH	VH	VH	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Environmental Unit Matrix
(Nonelectrical)
Archaeological Resources

Table 69 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
Milling Station (1)	0	L	L	L	L	L	0	M	U	L	L	M	M	M	0	0	0
UNIT # 7																	
Village (1)	0	L	M	H	H	H	M	H	U	H	H	VH	VH	VH	0	0	0
Camps (3)	0	L	M	H	H	H	M	H	U	H	H	VH	VH	VH	0	0	0
Lithic Scatter (1)	0	0	M	M	M	M	L	H	U	H	M	VH	VH	VH	0	0	0
Caves (5)	0	0	0	L	M	M	L	H	U	L	L	L	L	L	0	0	0
Petroglyphs (1)	0	0	0	L	M	L	0	H	U	L	L	VH	VH	VH	0	0	0
Milling Stations (3)	0	L	L	L	L	L	0	M	U	L	L	M	M	M	0	0	0
UNIT # 8	Island	Area															
Camp (1)	0	L	M	H	H	H	M	H	U	H	H	VH	VH	VH	0	0	0
Lithic Scatters (5)	0	0	M	M	M	M	L	H	U	H	M	VH	VH	VH	0	0	0
Milling Station (1)	0	0	L	L	L	L	0	M	U	L	L	M	M	M	0	0	0
UNIT # 9																	
Camps (5)	0	L	M	H	H	H	M	H	U	H	H	VH	VH	VH	0	0	0
Lithic Scatters (3)	0	0	M	M	M	M	L	H	U	H	M	VH	VH	VH	0	0	0
Milling Station (1)	0	0	L	L	L	L	0	M	U	L	L	M	M	M	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH- Very High

HONEY LAKE VALLEY GEOTHERMAL PROJECT

Environmental Unit Matrix
(Nonelectrical)
Archaeological Resources

Table 69 (Continued)

Potential Leasing Unit / Components	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. & Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Re-move Equip. & Rehab.	Surface Reclama-tion
UNIT #10																	
Unsurveyed	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U	U
UNIT #11																	
Camps (9)	0	L	M	H	H	H	M	H	U	H	H	VH	VH	VH	0	0	0
Lithic Scatters (3)	0	0	M	M	M	M	L	H	U	H	M	VH	VH	VH	0	0	0

Impact Ratings: U-Unknown, 0-None, L-Low, M-Moderate, H-High, VH-Very High

OVERALL ENVIRONMENTAL IMPACT MATRIX
ALL POTENTIAL LEASE UNITS (ELECTRICAL DEVELOPMENT)
HONEY LAKE VALLEY GEOTHERMAL PROJECT

TABLE 70

NOTE: These ratings are for unmitigated impacts

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. and Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l. Well Dev.	Const. Power Lines	Prod. and Use	Main-ten-ance	Aban-don Wells	Re-move Equip. and Rehab.	Sur-face Reclam-ation
I. Non-Living Components A. Air Air Movement Patterns	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temperature & Humidity	0	0	0	0	0	0	U	0	U	0	0	0	0	0	U	0	0	0	0
Particulate Matter	0	0	-L	-L	-L	0	-L	-L	-L	-L	-M	-L	-L	-L	-L	0	+L	0	+L
Noxious Gases	0	0	0	0	0	U	U	0	U	-L	0	0	0	0	U	0	+L	0	0
Non-ionizing Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	-L	-L	-H	-M	-L	-H	0	-L	-L	-L	-L	-L	0	+L	0	0
B. Soils 419	0	0	-L	-M	-M	-L	-H	-M	0	±H	-L	-L	-M	-L	0	0	-L	-L	+H
420	0	0	0	0	0	0	-M	-L	0	±H	-L	-L	-L	-L	0	0	-L	-L	+H
423	0	0	-L	-L	-L	0	-M	-M	0	±H	-L	-L	-L	-L	0	0	-L	-L	+H
425	0	0	0	0	0	0	-L	-L	0	±H	-L	-L	-L	-L	0	0	-L	-L	+H
426	0	0	0	0	0	0	-L	-L	0	±H	-L	-L	-L	-L	0	0	-L	-L	+H
4063	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	-M	-H	-L	0	0	-L	-L	+H
4064	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	-M	-H	-VL	0	0	-L	-L	+H

Impact Ratings: U-Unknown, 0-None, VL-Very Low, L-Low, M-Moderate, H-High, VH-Very High, + = Beneficial, - = Adverse

TABLE 70 (Continued)

OVERALL ENVIRONMENTAL IMPACT MATRIX
ALL POTENTIAL LEASE UNITS (ELECTRICAL DEVELOPMENT)
HONEY LAKE VALLEY GEOTHERMAL PROJECT

NOTE: These ratings are for unmitigated impacts

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. and Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l. Well Dev.	Const. Power Lines	Prod. and Use	Main-ten-ance	Aban-don Wells	Re-move Equip. and Rehab.	Sur-face Reclam-ation
C. Water																			
Runoff	0	0	-L	-M	-M	-VL	-H	-M	0	-H	0	-L	-L	-VL	0	0	-VL	-VL	+H
Groundwater	0	0	0	0	0	-H	-M	-M	0	-H	0	0	0	0	0	0	0	0	0
Recharge	0	0	0	-L	-L	0	-H	0	-M	0	0	0	0	0	0	0	0	0	+M
Sedimentation	0	0	-L	-M	-M	-VL	-H	-M	0	-H	0	-L	-L	-L	-L	-L	-L	-L	+H
II. Living Components A. Plants Terrestrial (All)	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-M	-M	-M	-M	-M	-L	+VL	-L	+M
B. Animals Livestock	0	0	0	-L	-L	0	0	-L	0	U	-L	-L	-L	-L	0	0	0	0	+L
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Horn Sheep	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Raptors	-VL	-VL	-VL	-M	-M	-M	-M	-M	-M	-M	-M	-M	-M	-M	-M	-M	-L	-L	-L
Endangered and Threatened Species	0	0	0	-L	-M	-M	-M	-M	-M	-M	-L	-M	-M	-M	-M	-L	-L	-L	-L

Impact Ratings: U-Unknown, 0-None, VL-Very Low, L-Low, M-Moderate, H-High, VH-Very High, + = Beneficial, - = Adverse

TABLE 70 (Continued)

OVERALL ENVIRONMENTAL IMPACT MATRIX
ALL POTENTIAL LEASE UNITS (ELECTRICAL DEVELOPMENT)
HONEY LAKE VALLEY GEOTHERMAL PROJECT

NOTE: These ratings are for unmitigated impacts

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT					PRODUCTION OF ENERGY				CLOSE OUT		
Components	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. and Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Power Plant Const.	Add'l. Well Dev.	Const. Power Lines	Prod. and Use	Main-ten-ance	Aban-don Wells	Re-move Equip. and Rehab.	Sur-face Reclam-ation
Waterfowl	0	-VL	-VL	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-VL	-VL	-VL
III. Human Values																			
A. Aesthetics	0	0	-M	-H	-H	-M	-M	-H	-L	-M	-H	-H	-H	-H	-H	-H	0	-H	+L
Recreation	-VL	-VL	-VL	-L	-L	-VL	-VL	-L	-VL	-L	-M	-M	-L	-L	-L	-L	0	-L	+VL
B. Archaeology Group A	0	-L	-M	-H	-H	-H	-M	-H	U	-H	-H	-VH	-H	-H	-L	-L	0	0	0
Group B	0	0	0	0	0	0	-VL	0	U	0	0	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, VL-Very Low, L-Low, M-Moderate, H-High, VH-Very High, + = Beneficial, - = Adverse

OVERALL ENVIRONMENTAL IMPACT MATRIX
ALL POTENTIAL LEASING UNITS (NONELECTRICAL DEVELOPMENT)
HONEY LAKE VALLEY GEOTHERMAL PROJECT

TABLE 71

NOTE: These ratings are for unmitigated impacts

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
COMPONENTS	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. and Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Remove Equip. and Rehab.	Surface Reclama-tion
I. Non-Living Components																	
A. Air																	
Air Movement Patterns	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Temperature and Humidity	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Particulate Matter	0	0	-L	-L	-L	0	L	0	0	-L	-L	0	0	0	0	-L	+L
Noxious Gases	0	0	-VL	-VL	0	U	U	0	U	-L	0	0	0	0	0	0	0
Non-Ionizing Radiation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Noise	0	0	0	-L	-L	-M	-M	-L	-M	0	-L	0	0	0	0	-L	0
B. Soils																	
419	0	0	-L	-M	-M	0	-H	-M	0	±H	-L	-L	-L	-L	-VL	-VL	+H
420	0	0	0	0	0	0	-M	-L	0	±H	-L	-L	-L	-L	-L	-L	+H
423	0	0	-L	-L	-L	0	-M	-M	0	±H	-L	-L	-L	-L	-L	-L	+H
425	0	0	0	0	0	0	-L	-L	0	±H	-L	-L	-L	-L	-L	-L	+H
426	0	0	0	0	0	0	-L	-L	0	±H	-L	-L	-L	-L	-L	-L	+H
4063	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	-L	-L	-L	0	-VL	+H
4064	0	0	-M	-H	-H	0	-H	-H	0	-H	-L	-L	-L	-L	-VL	-VL	+H

Impact Ratings: U-Unknown, O-None, VL-Very Low, L-Low, M-Moderate, H-High, VH-Very High, + = Beneficial, - = Adverse

OVERALL ENVIRONMENTAL IMPACT MATRIX
ALL POTENTIAL LEASING UNITS (NONELECTRICAL DEVELOPMENT)
HONEY LAKE VALLEY GEOTHERMAL PROJECT

TABLE 71 (Continued)

NOTE: These ratings are for unmitigated impacts

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
COMPONENTS	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. and Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Remove Equip. and Rehab.	Surface Reclama-tion
C. Water																	
Runoff	0	0	-L	-M	-M	0	-H	-L	0	-H	0	0	0	0	0	0	+H
Groundwater	0	0	0	0	0	-H	-H	-L	0	-H	0	0	0	0	0	0	0
Recharge	0	0	0	-L	-L	0	-L	-L	0	-H	0	0	0	0	0	0	+M
Sedimentation	0	0	-VL	-M	-M	-VL	-H	-M	0	-H	-VL	0	0	0	-L	-L	+H
II. Living Components A. Plants Terrestrial (All)	0	0	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	-L	0	-L	+M
B. Animals Domestic	0	0	0	-L	-L	0	0	-L	0	U	0	-L	-L	-L	0	0	+L
Antelope Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mule Deer Summer Range	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Big Horn Sheep	-VL	-VL	-VL	-VL	-VL	-VL	-VL	-VL	-VL	-VL	-VL	-VL	-VL	-VL	0	0	0
Raptors	-VL	-VL	-VL	-M	-M	-M	-M	-M	-M	-M	-M	-M	-M	-M	-L	-L	-L
Endangered and Threatened Species	0	0	0	- L	- M	- M	- M	- M	- M	- M	- L	- L	- L	- L	- L	- L	- L

Impact Ratings: U-Unknown, 0-None, VL-Very Low, L-Low, M-Moderate, H-High, VH-Very High, + = Beneficial, - = Adverse

OVERALL ENVIRONMENTAL IMPACT MATRIX
ALL POTENTIAL LEASING UNITS (NONELECTRICAL DEVELOPMENT)
HONEY LAKE VALLEY GEOTHERMAL PROJECT

TABLE 71 (Continued)

NOTE: These ratings are for unmitigated impacts

	PRELIMINARY EXPLORATION			EXPLORATORY DRILLING				FIELD DEVELOPMENT				NON-ELECTRICAL PRODUCTION			CLOSE OUT		
COMPONENTS	Air-borne	Off-Road (Foot)	Off-Road Vehicle	Road Const. and Use	Drill Site Dev.	Drill-ing	Well Test-ing	Int. Well Dev.	Well Vent-ing	Waste Dis-posal	Pipe-line Dev.	Food Pro-duct Proc.	Green Houses	Single Cell Protein Prod.	Aban-don Wells	Remove Equip. and Rehab.	Surface Reclama-tion
Waterfowl	-VL	-VL	-VL	-L	-L	-L	-L	-L	-L	-L	-L	-VL	-VL	-VL	-L	-L	-L
III. Human Values A. Aesthetics	0	0	-L	-M	-M	-L	-L	-M	-VL	-L	-M	-M	-M	-M	-M	-M	+L
Recreation																	
B. Archaeology Group A	0	-L	-M	-H	-M	-H	-M	-H	U	-H	-M	-VH	-VH	-VH	0	0	0
Group B	0	0	0	0	-VL	0	0	0	U	0	0	0	0	0	0	0	0

Impact Ratings: U-Unknown, 0-None, VL-Very Low, L-Low, M-Moderate, H-High, VH-Very High, + = Beneficial, - = Adverse

IV. MITIGATING OR ENHANCING MEASURES

BLM intends the Honey Lake EAR to be the basic reference document for the design of surface protection features. Therefore, the lessee will be required, in his Plans of Operation, to reference his activities to the below-described mitigating measures.

The Bureau of Land Management is committed to assuring that each of the below mitigating measures are incorporated where applicable by the lessee in his Plans of Operation.

The following statement will be attached to all geothermal leases associated with this EAR:

> Prior to the development of a Plan of Operation (43 CFR 3203.6 - 30 CFR 270.34), the Lessee shall contact the Supervisor and Authorized Officer to review local ground rules, applicable regulations, GRO Orders and pertinent special stipulations. This requirement may be waived by the mutual consent of the Authorized Officer and Supervisor after it has been determined that the Lessee is thoroughly familiar with surface management problems and requirements for operations on the lease.

In addition, all applicable Federal, State and County laws, rules, regulations, ordinances, and orders that pertain will be adhered to as appropriate.

If an alternative, as presented in Chapter VIII of this EAR, other than the proposed action, is selected for implementation, the mitigation measures as outlined in this chapter will be modified to appropriately address the specific conditions of the alternative.

Mitigation measures proposed for electrical development are suitable for use on nonelectrical development as well.

A. Non-Living Components

1. Geology

The following impacts on geology have been identified. With each anticipated impact are applicable laws and regulations which serve as means of mitigation. The Area Geothermal Supervisor, U.S. Geological Survey, has the primary regulatory responsibility for geothermal activities conducted on geothermal leases.

Impacts	Existing Mitigating Measures
Subsidence	1. GRO Order No. 4, Sec. 8 A, B, C.
	2. Title 30 CFR 270.43
Induced Seismicity	1. GRO Oder No. 4, Secs. 8D, 9C.
	2. 30 CFR 270.43
Accelerated Slope Instability	1. GRO Order No. 4, Sec. 5.

In addition to the mitigating measures provided by GRO Order No. 4 entitled "General Environmental Protection Requirements," numerous measures are contained in the Federal Code of Regulations Title 30, Parts 270.34(b), 270.37, 270.43, 270.48, 270.76 and 43 CFR Part 3204.1(e). These regulations particularly concern the prevention and control of induced seismicity, subsidence, landslides, and unstable foundation materials.

2. Soils

Impacts identified from well site, access road and pipeline location, construction, use and rehabilitation include soil erosion and compaction. Mitigation of these impacts presently exists in the way of pre-construction requirements: A Plan of Operation (30 CFR 270.34) and a Notice of Intent to Conduct Geothermal Resource Exploration Operations (Form 3200-9). These requirements allow for the establishment of site-specific surface protection stipulations prior to any construction activity.

The following are mitigating measures for soil erosion and compaction from the various activities involved.

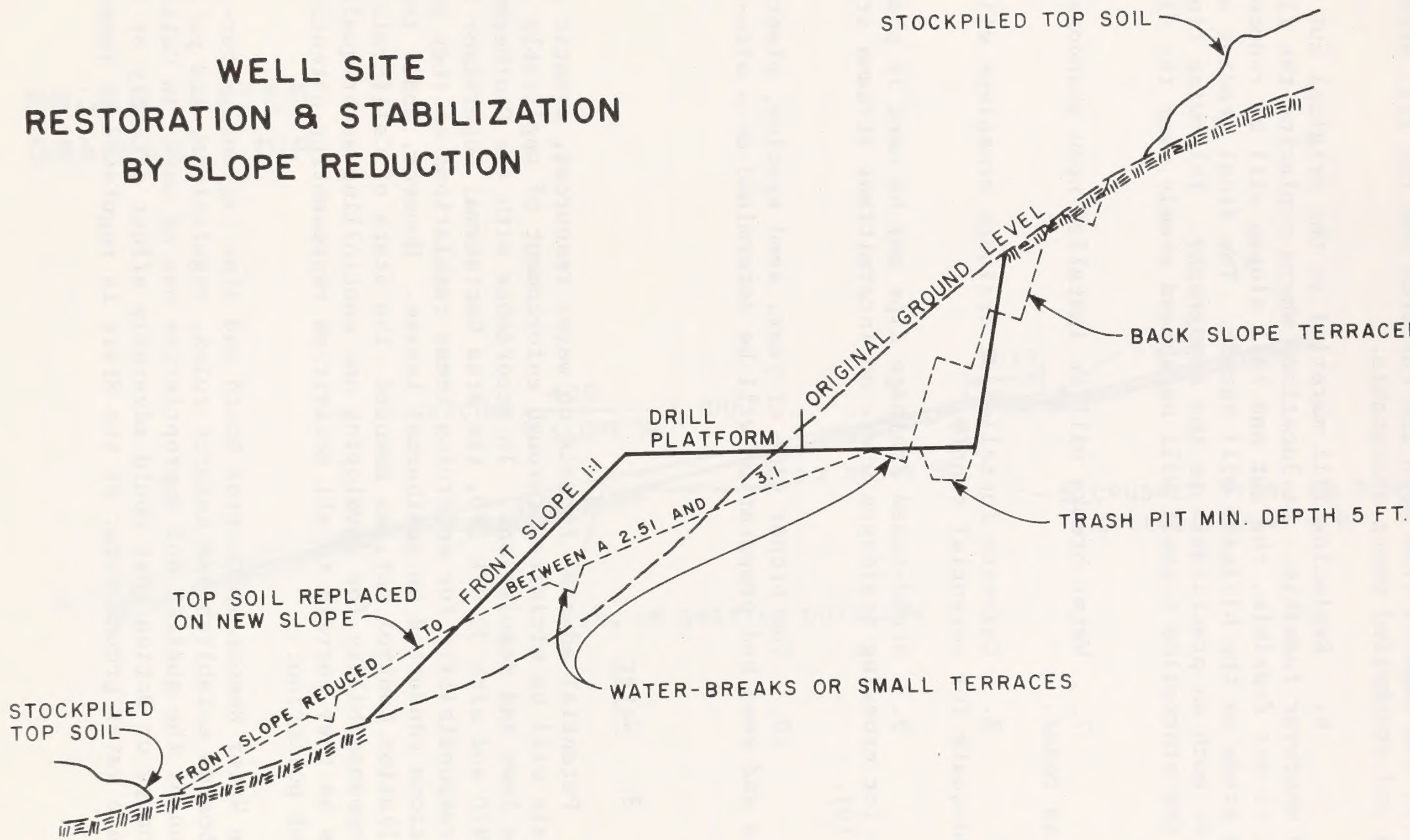
1. Well sites will be located as often as practical on level terrain. Steep hillsides will be avoided where possible.

2. Where conditions permit, rehabilitated cut and fill slopes will be reduced to less than a 3:1 grade (see FIGURE 18).

3. All operations are subject to temporary suspension as ordered by the Supervisor during periods of inclement weather.

4. Initial access roads to exploratory wells will be constructed as temporary roads with plans towards eventual rehabilitation and closure.

WELL SITE RESTORATION & STABILIZATION BY SLOPE REDUCTION



SOURCE: Miller, Wm. B. Page 2

FIGURE 18

5. Where cuts and fills disturb a significant quantity of topsoil, the topsoil from both the cut area and the fill area will be stripped and stockpiled where acceptable.

6. Replacing fill material in the original cut will be required wherever feasible. At locations where replacing the fill material is not feasible, the cut and fill slopes will be reduced to as gentle a grade as the hillside will permit. The final grading will conform as much as practicable to the topography. Following final grading the stockpiled topsoil will be spread evenly over the disturbed area.

7. Water breaks will be installed upon abandonment of all access roads.

8. Culverts installed at drainage crossings will be of a size adequate for potential runoff.

9. Broad-based drainage dips may be used in place of culverts for crossing drainages where no intermittent streams are present (FIGURE 19).

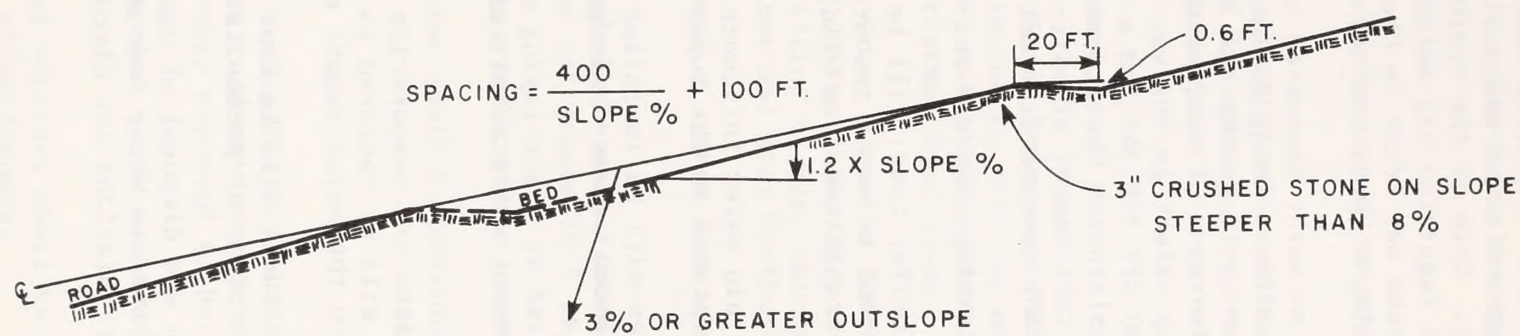
10. The proper time of year, seed species, planting technique and seed bed preparation will be determined on a site-specific basis.

3. Water

Potential adverse impacts on water resources, aquatic plants and animals will be minimized through enforcement of applicable Federal and State laws and regulations. In accordance with the Geothermal Steam Act of 1970 and with 30 CFR 270, the Area Geothermal Supervisor has the primary responsibility for enforcing these regulations as they pertain to operations conducted on geothermal leases. However, under the Federal Water Pollution Control Act, as amended, the State of California has the primary responsibility for developing and controlling water-quality standards as they pertain to all activities representing potential point sources of pollution.

The State Water Resources Control Board and nine regional water-quality control boards establish and enforce rules, regulations, and policy for protection of the quality and appropriative use of water in California. Any discharge or action that could adversely affect directly or indirectly the surface water ground water of the State is regulated by these boards.

BROAD-BASED DRAINAGE DIP



SOURCE: Miller, Wm. B. Page 23

FIGURE 19

In general, the State Water Resources Control Board formulates statewide policy, administers appropriative water rights, and hears appeals on regional board actions. Each of the regional water-quality control boards administers and regulates all water-quality matters within specific geographic areas set forth in Chapter 4, Article 1, Section 13200 of the Porter-Cologne Water Quality Control Act.

The following impacts on water resources have been identified: increased siltation and stream sediment load; pollution of groundwater aquifers and surface waters from toxic geothermal fluids and waste fluids; sealing off of spring flow; diversion of surface water drainages. Mitigation of these impacts presently exists in the way of pre-construction requirements: A Plan of Operation (30 CFR 270.34) and a Notice of Intent to Conduct Geothermal Resource Exploration Operations (Form 3200-9). These requirements allow for the establishment of site-specific surface protection stapulations prior to any construction activity.

The following are mitigating measures for the above mentioned impacts.

1. A strip of land (buffer zone) will be maintained at a specified width immediately adjacent to water resources within which activities will be restricted or prohibited (see Wildlife, Upland Game and Small Game, 1).

2. Proposed roads within water influence zones will be located, designed and constructed as acceptable to the Supervisor.

3. Culverts or bridges will be installed as required by the Supervisor where roads are constructed across drainages.

4. Operation of wheeled or track-laying equipment will be prohibited along stream courses except where permitted by the Supervisor at drainage crossings.

5. When stream drainages are temporarily diverted during lease operations, the stream flow will be restored to the natural course as soon as practicable and prior to the major runoff season.

6. Erosion control features will be kept in operational order particularly before seasonal periods of precipitation or runoff.

7. The transportation and disposal of waste will be conducted in accordance with the California Water Code and California Administrative Code. The applicable regulations are discussed in APPENDIX 6.

Additional mitigating measures for waste discharge are as follows:

A. Discharge Prohibitions:

1. The direct discharge of wastes of any nature to surface waters is prohibited.

2. The discharge of drilling muds, oils, and associated waste water to any sump not approved by the Leasing Officer and the Area Geothermal Supervisor is prohibited.

B. Discharge Specifications:

1. The discharge of Group 1 wastes (APPENDIX 6) into drilling sumps shall be limited to drilling materials, formation fluids, and other selected materials approved by the Leasing Officer and the Area Geothermal Supervisor.

2. The discharge of Group 2 wastes (APPENDIX 6) at disposal sumps shall be limited to the chemically and biologically decomposable components of drilling fluids, unless otherwise authorized by the leasing Officer and Area Geothermal Supervisor.

3. A minimum freeboard of three feet shall be maintained in the waste sumps.

4. The waste sumps shall be constructed in such a way that the permeability does not exceed 10^{-6} cm/sec.

5. There shall be no overflow from the waste sumps.

6. Sanitary facilities shall be provided at each drill site.

C. Provisions:

1. Wastes produced during the drilling site preparation, road construction, and road maintenance shall be placed where they cannot be reasonably expected to be carried into the waters.

2. All roads and exposed earth surfaces shall be protected from erosion.

3. Waste confinement barriers shall be protected and maintained to ensure their effectiveness.

4. Neither surface nor subsurface drainage from tributary areas shall be discharged to waste sumps.

5. The exterior surfaces of the disposal area shall be graded to promote lateral runoff of precipitation and to prevent erosion.

6. The discharger shall remove and relocate any wastes which are discharged at this site in violation of these requirements.

7. Any waste removed from waste sumps shall only be discharged to an approved disposal site.

8. The disposal sumps shall be protected from any washout or erosion of waste or covering material, and from inundation, which could occur as a result of floods having a predicted frequency of once in 100 years.

9. Within 90 days after the completion of all waste discharges to any sump, unless otherwise extended by the Area Geothermal Supervisor, the sump shall be buried, graded, and the area revegetated.

Further regulations concerning notification of discharge and monitoring programs are included in APPENDIX 7.

4. Air and Noise

Air. Mitigating measures for prevention and control of air pollution are included in existing leasing and operating regulations, lease terms and GRO Orders. TABLE 72 lists applicable sections of the various regulations pertaining to air and noise with which a lessee must comply. GRO Order No. 4, titled "General Environmental Protection Requirements," contains a compendium and elaboration of the regulations.

As stated in GRO Order No. 4, noncondensible gases vented into the atmosphere shall not exceed Federal, State, or regional air pollution standards. If standards are exceeded, especially since all gases associated with this geothermal area are not known, measures will be taken to bring air quality and gaseous emissions within the standards established. See the Ambient Air Quality Standards for Lassen County Air Pollution Control Board, TABLE 73. This may be in the form of periods of limited operation, development of new gas extraction devices, or decreases in gaseous emissions through use of improved technology. Since monitoring of air quality is required, any unknown impacts may be mitigated as they arise by requiring the application of existing or new technology.

Mitigation of the impacts of noncondensible gases in geothermal fluids can be partially accomplished by reduction of emissions to the atmosphere, removal of gases by filtration, absorption of gases and conversion of gases to other compounds. The actual technology used depends on many variables, particularly the nature and amount of noncondensible gases in the geothermal reservoir.

TABLE 72

REGULATIONS APPLICABLE TO AIR RESOURCES AND NOISES

Sections	Regulations
3204.1(c)(3) 3204.1(c)(5) 3204.1(c) 3204.1(J) 3210.2-1(d) 3244.3	Leasing Regulations (Title 43, Chap. II, CFR)
270.11 270.12(d) 270.30 270.34(h)(5) 270.34(j) 270.34(k)	Operating Regulations (Title 30, Chap. II, CFR)
8 12 14 15 25	Lease Stipulations (BLM Geothermal Resources Lease, Form 3200-1)

TABLE 73
AMBIENT AIR QUALITY STANDARDS
APPLICABLE IN
LASSEN COUNTY AIR POLLUTION CONTROL DISTRICT

Pollutant	Averaging Time	California Standards		Federal Standards[4]		
		Concentration[7]	Method[1]	Primary[2,7]	Secondary[3,7]	Method[5]
Photochemical Oxidents (Corrected for NO_2)	1 hour	0.10 ppm (200 ug/m3)	Neutral Buffered KI	160 ug/m3 [8] (0.08 ppm)	Same as Primary Std.	Chemiluminescent Method
Carbon Monoxide	12 hours	10 ppm (11 mg/m3)	Non-Dispersive Infrared Spectroscopy	---	Same as Primary Standards	Non-Dispersive Infrared Spectroscopy
	8 hours	---		10 mg/m3 (9 ppm)		
	1 hours	40 ppm (46 mg/m3)		40 mg/m3 (35 ppm)		
Nitrogen Dioxide	Annual Average	---	Saltzman Method	100 ug/m3 (0.05 ppm)	Same as Primary Standard	Colorimetric Method Using NaOH
	1 hour	0.25 ppm (470 ug/m3)		---		
Sulfur Dioxide	Annual Average	---	Conductimetric Method	80 ug/m3 (.03 ppm)	60 ug/m3 (0.02 ppm)	Pararosaniline Method
	24 hours	0.04 ppm (105 ug/m3)		365 ug/m3 (0.14 ppm)	260 ug/m3 (0.10 ppm)	
	3 hours	---		---	1300 ug/m3 (0.5 ppm)	
	1 hour	0.5 ppm (1310 ug/m3)		---	---	
Suspended Particulate	Annual Geometric Mean	60 ug/m3	High Volume Sampling	75 ug/m3	60 ug/m3	High Volume Sampling
	24 Hours	100 ug/m3		260 ug/m3	150 ug/m3	
Lead (Particulate)	30 Day Average	1.5 ug/m3	High Volume Sampling, Dithizone Method	---	---	---
Hydrogen Sulfide	1 hour	0.03 ppm (42 ug/m3	Cadmium Hydroxide STRactan Method	---	---	---
Hydrocarbons (Corrected for Methane)	3 hours (6-9 a.m.)	---	---	160 ug/m3 (0.24 ppm)	Same as Primary Standard	Flame Ionization Detection Using Gas Chromatography
Visibility Reducing Particles	1 observation	In sufficient amount to reduce the prevailing visibility[6] to 10 miles when the relative humidity is less than 70%.		---	---	---

NOTES:

1. Any equivalent procedure which can be shown to the satisfaction of the Air Resources Board to give equivalent results at or near the level of the air quality standard may be used.

2. National primary Standards: The levels of air quality necessary, with an adequate margin of safety, to protect the public health. Each state must attain the primary standards no later than three years after that state's implementation plan is approved by the Environmental Protection Agency (EPA).

3. National Secondary Standards: The levels of air quality necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant. Each state must attain the secondary standards within a "reasonalbe time" after implementation plan is approved by the EPA.

4. Federal standards, other than those based on annual averages or annual geometric means, are not to be exceeded more than once per year.

5. Reference method as described by the EPA. An "equivalent method" of measurement may be used but must have a "consistent relationship to the reference method" to be approved by the EPA.

6. Prevailing visibility is defined as the greatest visibility which is attained or surpassed around at least half of the horizon circle, but not necessarily in continuous sectors.

7. Concentration expressed first in units in which it was promulgated. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 mm of mercury.

8. Corrected for SO_2 in addition to NO_2.

Since the nature of the geothermal reservoir is not known, it is not feasible at this time to designate technical mitigating measures to decrease toxic noncondensible gaseous emissions. However, at the Plan of Operations stage, such specific measures will be addressed, in conjunction with the U. S. Geological Survey, Area Geothermal Supervisor, who is charged with enforcement of regulations and stipulations on Federal geothermal leases. Existing technology will be used to decrease emissions of all gases present in concentrations capable of exceeding Federal, State or local air standards.

The following will be used as guidelines which will be implemented where necessary in specific plans of operation on a case-by-case basis:

1. Heavily used dirt roads and areas where vegetation has been removed and heavy equipment activity is great will be watered down to decrease levels of construction-related and windblown particulate matter in the air.

2. Areas denuded of vegetation during development will be revegetated when construction activity has ceased in order that introduction of particulate matter by blowing dust be minimized.

3. If during the leasing phase, it is brought to the attention of the BLM that certain air emissions would significantly impact plant, animal or human health, a monitoring program will be initiated and emission controls required if necessary.

4. If it is determined that significant amounts of H_2S are being emitted during exploration, the lessee will limit venting or well testing to days when inversion conditions are not prevalent.

5. If it is determined that temperature and humidity changes from well or power plant emissions would cause significant impacts, the lessee would install temperature and himidity monitoring stations and transfer and steam emission controls.

Noise. Mitigating measures for most on-site impacts are covered under existing regulations and GRO Orders. In particular, the Occupational Safety and Health Act of 1970 and Part II of GRO Order No. 4 address such impacts. Occupational noise impacts are usually abated by the use of hearing protective devices by workers. GRO Order No. 4 directs the lessee to minimize noise and provides for measurement criteria, assessment and attenuation of objectionable noises.

Additional mitigating measures are as follows:

1. All motor exhausts of drill rig engines, compressors and construction equipment will be directed into mufflers.

2. To mitigate impacts of noise from possible development on the community of Wendel (in Potential Leasing Unit 6), wells and especially power plants will be located as far from Wendel as possible. The noise level will be limited to 65 dB(A) during the day and 45 dB(A) at night in Section 30, T.29N., R.16E., along the lease boundary.

Particular attention will be paid to Potential Lease Units 2, 3, 4, 7, 9 and 10 where valuable wildlife habitat will be affected by any development that might occur. For detailed measures to mitigate potential impacts from noise on wildlife, see the section in this chapter on wildlife.

Many off-site impacts are mitigated by existing regulations and orders. For example, GRO Order No. 4 requires that noise levels not exceed 65 dB(A) at the lease boundary or one half mile from the source, which ever is greater. However, additional and/or more stringent measures may be required in some instances, such as when continuing human or wildlife community disturbance occurs.

One means of mitigating off-site impacts is to increase the distance of the noise source from the area impacted, since sound decreases six dBs for each doubling of distance from the source. Where this is not feasible increased use of mufflers and deflection devices may be required.

B. Living Components

1. Vegetation

A plan of operations covered under (30 CFR 270.34 - land uses) will be required prior to entering on the leased lands.

1. Temporary trail construction will be held to a minimum and be for short term use.

2. Operations will be subject to temporary suspension during periods of intense runoff or ground thaw.

3. Topsoil will be stockpiled from all disturbed areas for reuse. It will be located so as to prevent mixing with subsurface materials.

4. All disturbed areas not occupied by roads, wells, buildings, storage, etc., will be reseeded to adapted soil-stabilizing grasses, forbs, shrubs and trees. Native vegetation should be restored when seeds of these species are obtainable.

5. The leased lands are in an area where endangered or threatened plant species may occur. All viable habitat for any of these species will be identified by the Bureau of Land Management (BLM) for the lessee during the preliminary environmental review of the lessee's proposed surface disturbing activity (i.e., any plan of operation). This analysis shall also include, on the initiative of BLM, formal consultation pursuant to section 7 of the Endangered Species Act of 1973, (see Federal Register 43(2): 870-876, January 4, 1978). This consultation with the U. S. Fish and Wildlife Service would determine whether or not the proposed activity will jeopardize the continued existence of any identified endangered or threatened species. This process may consume several months and may require certain restrictions on surface disturbance. To accelerate this process, the lessee may provide a statement from a botanist acceptable to the District Manager, identifying the impacts that any proposed operations would have on endangered or threatened plant habitat."

2. Livestock

Potential adverse impacts on livestock would be minimized through enforcement of applicable Federal and State laws and regulations. According to 43 CFR 3204.1-b, although "restrictions on access will not be allowed without prior approval," the lessee will be responsible for regulating "public access and vehicular traffic to protect the public, wildlife and livestock from hazards associated with the project. For this purpose, the lessee shall provide warnings, fencing, flagmen, barricades and other safety measures as appropriate."

3. Wildlife

The following are mitigating measures for impacts of the proposal identified for various wildlife groups.

Antelope, Mule Deer and California Bighorn Sheep.

1. No surface disturbance will be permitted within all canyons in the Amedee Mountain range. These areas are critical summer range for the aforementioned species.

2. Should previously unidentified wildlife habitat of significant value be encountered the Supervisor will be notified and action will be taken to minimize the disturbance.

Upland Game and Small Game

1. To assure the availability of free water and green vegetation, no surface disturbance shall be permitted within 700 feet horizontally from any perennial stream, wet meadow, seeps or galinaceous guzzlers; or closer than 350 feet horizontally from any intermittent stream except as authorized by the Supervisor and Authorized Officer.

2. Potable water wells drilled in accordance with state water laws within the leased area by the lessee (pursuant to 1(c), Form 3200-21) will be assessed by the Bureau for potential use as a well site for other ongoing programs. The Susanville BLM District Manager will be notified prior to abandonment of said wells. Financial arrangements between the lessee, BLM and other agencies will be specified for takeover of said water wells prior to abandonment. The lessee will be released from all further liability for any such wells.

3. Potential hazards to wildlife such as sumps, evaporation pits and reservoirs etc., will be properly contained.

Waterfowl and Shore Birds

No surface disturbance or intrusion will be allowed within one-half mile of:

1. Waterfowl production areas, brooding, resting, staging and/or molting areas.

2. Wetland habitat determined as valuable migratory shore bird habitat.

3. No power plant construction will be allowed within one mile of Honey Lake Wildlife Area.

Birds of Prey (Raptors)

1. No surface disturbance or intrusion will be allowed within one-half mile of all identified raptor eyries. See APPENDIX 8 for pertinent existing laws.

2. An additional one-half mile buffer zone will be established around active raptor eyries between February 1 and September 1 of each year. During the remainder of the year surface disturbance will be permitted in the additional one-half mile buffer zone with provision that no permanent surface structures shall be constructed.

3. Powerlines and towers will be constructed to prevent electrocution of raptors. Design of towers and powerlines must be declared raptor safe by a raptor expert and these designs will be made a part of the lease.

Threatened and Endangered Species

1. Endangered species habitat will be considered critical habitat and protected in accordance with the Endangered Species Act of 1973. At present there are no mammals, fish or invertebrates in danger of extinction or classified as threatened or endangered within the study areas. The Southern Bald Eagle is a regular winter visitor; this species will be monitored to insure protection. If it is determined that further protection is necessary, efforts will include preservation of the following habitat components:

a. Space for normal growth, movement or territorial behavior.

b. Nutritional components of habitat such as food, water, minerals.

c. Sites for breeding, reproduction or rearing of offspring.

d. Cover or shelter.

e. Seasonal restriction of occupancy.

f. Other biological, physical or behavorial requirements as needed.

This protection will also include the following stipulation on all leases:

> The leased lands are in an area where the Bald Eagle, an endangered species, is known to occur. All viable habitat of this species will be identified by the Bureau of Land Management for the lessee during the preliminary environmental review of the lessee's proposed surface disturbing activity (i.e., any plan of operation). This analysis shall also include, on the initiative of the Bureau of Land Management, formal consultation pursuant to section 7 of the Endangered Species Act of 1973 (see Federal Register 43(2): 870-876, January 4, 1978). This consultation with the U. S. Fish and Wildlife

Service will determine whether or not the proposed activity will jeopardize the continued existence of the Bald Eagle. This process may consume several months and may require certain restrictions on surface distrubance. To accelerate this process, the lessee may be required to provide a statement from a wildlife biologist acceptable to the District Manager, identifying the impacts that any proposed operations will have on the Bald Eagle or its habitat."

2. If further investigations reveal the occurrence of other species classified as threatened or endangered, they will be protected as above.

C. Human Interest Values

1. Aesthetics

Many of the mitigating measures previously described in other sections will also help mitigate impacts on aesthetics. Following are some additional measures.

a. Travel routes should be located along the base of slopes whenever possible in order to minimize visibility by taking advantage of the existing line between distinct changes in slope, and by locating the road in the least obvious visual prominence zone.

b. New dirt roads should be constructed only as necessary to allow access for equipment that could not otherwise gain access on existing roads.

c. The creation of straight roads should be avoided where feasible so that unnatural lines will not be introduced into the landscape. Curves that follow existing landforms are more in harmony with the natural landscape.

d. Gravel should be used only where necessary to improve the support characteristics of the existing surface.

e. New surfaced roads should be built only where gravel-improved dirt roads would not physically support the intended use.

f. Excavation for the purpose of obtaining materials for use in construction or fill activities may not be permitted within the geothermal lease area unless authorized by the Supervisor and the Authorized Officer.

g. For pipelines, surface disturbance will be limited to the pipeline and service road proper. Excavated materials should be placed along the pipeline in such a manner to assure their retention for replacement in the approximate original positions when removal and rehabilitation of the pipeline occur. All pipelines and associated structures should be painted with nonreflective material to blend with the surrounding landscape.

h. The guidelines and criteria listed in the publication, Environmental Criteria for Electric Transmission Systems, (U.S. Department of the Interior and U.S. Department of Agriculture, 1970) will be used when planning electric transmission line design and routing.

i. Field development and production should not be allowed on Class II visual resource management lands.

2. Recreation

a. The decision to lease or not to lease within the boundary of potential wilderness areas identified as Wilderness Study Areas will be deferred until their status as actual wilderness is decided by Congress.

b. Those lands within potential wilderness areas which have existing resource values other than wilderness which will not now allow geothermal development will not be leased.

c. In order to protect the values of the potential wilderness area, construction of power plants will be at least one mile from the roadless area boundary. All other permanent facilities and structures within this one mile buffer zone will be assessed on a site-specific basis.

3. Archaeological and Historical Resources

A family of legislative acts, executive orders, and Federal rules and regulations proclaims it the policy of the Federal government to adopt a posture of protection and mitigation toward prehistoric and historic cultural resources, and directs Federal agencies to pursue actively such a policy with respect to the cultural resources which lie on the lands over which they have management responsibility. The most pertinent of the various regulations are contained in 34 Stat. 225, 49 Stat. 666, 74 Stat. 220, 80 Stat. 915, 88 Stat. 174, Executive Order 11593, and 36 CFR 800.

In order to insure compliance with this body of regulation, the following proceedures should be followed:

(1) No surface occupancy or disturbance will be allowed on those properties identified as potentially eligible for nomination to the National Register of Historic Places.

(2) No surface occupancy or disturbance will be allowed on other zones of potentially high impact on cultural resources (identified on the Leasing Unit Matrix).

(3) The antiquities stipulation listed below will replace Section 18 of all Geothermal resource Leases (Form 3200-21). This same stipulation (with words "lease", "lessee", and "lessor" changed to "Notice", "Undersigned", and "Authorized Officer") will be added to the Notice of Intent to Conduct Geothermal Resource Explorations (Form 3200-9) when surface disturbance of any sort is intended. Drilling of shallow holes as defined in Geothermal Resource Operational Order No. 1 (Federal Register Volume 39, No. 190, pp. 35192-35193, September 30, 1974) will be excluded from this stipulation provided that such holes are immediately adjacent to existing roads and trails and that the drill sites have been previously inspected and approved by the Authorized Officer and BLM cultural resource professionals.

<u>Antiquities and Objects of Historic Value - Section 18</u>

Prior to any operations under this lease, the lessee will engage a qualified archaeologist, acceptable to the Authorized Officer, to make an archaeological survey of the land to be disturbed or occupied. A certified statement, signed by the qualified archaeologist, setting out the steps taken in the survey and the findings thereof as to the existence of antiquities or other objects of historic or scientific interest, shall be submitted to the Authorized Officer. If the statement indicates the existence of such objects which might be disturbed by operations under this lease, the lessee shall take such steps as may be required by the Authorized Officer, including archaeological salvage. The responsibility for the cost for the certificate, survey and salvage will be borne by the lessee, and such salvaged property shall remain the property of the lessor.

The lessee shall immediately bring to the attention of the Authorized Officer any antiquities or other objects of historic or scientific value or interest, including but not limited to historic or prehistoric ruins, fossils, or artifacts discovered as a result of operations under this lease, and shall leave such discoveries intact. Failure to comply with any of the terms and conditions imposed by the Authorized Officer with regard to the preservation of antiquities may constitute a violation of the Antiquities Act (16 U.S.C. 431-433).

(4) The report required of the lessee in compliance with Section 18, above, in addition to identifying cultural resources in the area of potential disturbance, must:

a. Evaluate each identified site for significance in terms of National Register of Historic Places criteria, in consultation with the State Historic Preservation Officer.

b. Identify the nature and intensity of impacts anticipated from the proposed development, at a level sufficient to allow the determination of adverse effect and the preparation of a preliminary case report for the Advisory Council on Historic Preservation.

c. Designate specifically a proposed program of mitigation or avoidance (including non-occupancy, salvage collection, and excavation) to insure that cultural values will be preserved.

(5) The report will be reviewed for adequacy by the Susanville BLM and, if found adequate, will be transmitted to the State Historic Preservation Officer and the Advisory Council on Historic Preservation for comment.

(6) If found acceptable by the SHPO and the ACHP, the proposed mitigation plan will be implemented by the lessee through the agency of a qualified archaeologist acceptable to the Supervisor.

(7) If the proposed mitigation plan is found not acceptable by the SHPO or the ACHP, the lessee will be required to present an alternate plan or to opt for nonoccupancy of the area in question.

The attention of lessees is also directed to Geothermal Resource Operational Order No. 4 (40 F.R. 159, pp. 34427-34431).

4. Social and Economic Values

The noise impacts to the settlement of Wendel and the ranch residence at Amedee would be largely mitigated by application of GRO Order No. 4. This order would be enforced by the U. S. Geological Survey, Geothermal Supervisor at all stages of development of federally leased land.

Application of this GRO order would also reduce the area of the Waterfowl Management Area which would be affected by well drilling and well testing. With this mitigation, no part of the Waterfowl Management Area would be subjected to geothermal-caused noise in excess of 65 dB(A) unless permitted by the management of that Area. There could still be noise levels of 55 dB(A) or more as much as 4,500 feet into the Area.

V. UNAVOIDABLE ADVERSE IMPACTS

This chapter describes the adverse impacts which could be expected to remain after the applicable mitigation measures described in the preceding chapter have been applied. These impacts are therefore considered unavoidable.

A. Geology

The major impacts which cannot be totally mitigated are mostly related to the extraction of the subsurface geothermal resource. Drilling and related soil and substrata material displacement would result in some degree of adverse residual impact. The degree and full extent are unknown at this time. Precautions and mitigating measures should alleviate the potential for such problems as subsidence and induced seismicity. The long-term or net effect of geothermal resource extraction, if brought about by future leasing and development, cannot be predicted nor rated as to its impact at this time. It can be deduced that, should subsidence or seismicity occur, alteration of the landscape is possible. Likewise, the possibility of significant long-term damage to subsurface water tables and discharge characteristics of aquifers exists. It should be noted also, however, that little is known of technological capabilities or improvements which may be developed to avoid or minimize such impacts.

B. Soils

Topsoil and vegetation will be lost for the duration of use beneath roads, wells, disposal ponds, power plants, and other structures. Revegetation to native species will be only partially effective causing a loss of terrestrial vegetation with associated forage value reduction and some wildlife habitat degradation. Areas cleared of vegetation may be invaded by undesirable or low value plants. Revegetation with native or introduced species appears likely over long periods. Soil depth and structural changes will be permanent on many developed sites. Soil 419 is very susceptible to accelerated soil erosion. Revegetation on soils 420 and 423 will be difficult at best because soil alkalinity will limit success. On soil 423 it may be impossible to revegetate in some local areas. Some soil losses will be experienced due to increases in wind and water erosion during surface disturbance activities. The accumulation of toxic elements in the soil is possible, but remains an unknown residual impact due to the lack of research information.

The most sophisticated reclamation procedure cannot replace a natural soil structure nor can reseeding duplicate a natural flora.

C. Water

If increased seismic activity occurred, well and spring discharges may change adversely. Variables affecting this phenomenon include depth of charge, size of charge, geologic structure, kinds of parent material, and proximity of activity to the water sources.

Reinjection of liquid wastes could result in aquifer contamination over a long period of time. However, this technique of liquid waste disposal has proven successful when carefully engineered and monitored in other developed geothermal fields within the State. It is expected to provide an equally environmentally sound method of waste disposal in this area.

Discharge characteristics of existing hot springs may change in areas of development.

Surface-water quality is expected to be lowered temporarily due to accelerated erosion on disturbed sites. Mitigating measures, however, will reduce the preponderance of sediment degradation over the life of the project.

D. Air and Noise

1. Air

With mitigating measures applied there will still be an overall loss in air quality. There will be an increase in carbon monoxide and hydrocarbon levels from increased use of the internal combustion engine.

The emission of steam into the atmosphere from well drilling, testing and venting and the power plant operation will increase the local humidity slightly.

The noncondensible gases associated with this steam will also be emitted into the atmosphere in varying concentrations depending on what constituents are present.

The most noticeable, by its smell, and the one expected to present the greatest impact (through comparison of other geothermal areas) is hydrogen sulfide.

Air-quality standards may occasionally be exceeded, particularly during periods of temperature inversion. The cumulative effects of discharging noncondensible gases to the atmosphere during the period of production are unknown and may remain for future generations.

2. Noise

Noise levels will increase in developed areas during the life of the development. The greatest unavoidable impacts from the increased noise level would occur during the drilling and field development operations.

Generally, noise impacts cannot be completely mitigated throughout all stages of development and operation. With implementation of the proposed mitigating measures, most noise impacts in crucial areas will be alleviated.

E. Vegetation

Topsoil and vegetation will be lost for the duration of use on roads and trails, disposal sites, power plants, and other sites and structures. Revegetation of disturbed areas to native species will be partially effective. Some loss of forage values, wildlife habitat, and soil will be permanent.

Areas cleared of vegetation will be invaded to some degree by undesirable plants, such as halogeton, thistles, and noxious weeds. Equipment moving from other parts of the country will contribute to undesirable plant invasion as it carries seeds from one area to another.

As indicated under "Anticipated Impacts on Vegetation," the total of the residual impacts from development of geothermal steam for electrical energy production would probably be several times greater than the impacts of non-electrical uses.

F. Livestock

Depending on the extent and location of activity and the consequent loss of carrying capacity, livestock permits may require modification to reduce use. Established patterns of livestock use will be modified with development.

With an increase in human activity in the area livestock rustling could increase, thus causing an increased loss to the community economy. This, along with a loss of on-site forage, could add up to a significant dollar value to the livestock permittees.

The loss of livestock may occur should toxic substances be released in stock water sources or deposited on forage species, but the potential or probability of such an impact is unknown.

It is also highly probable that the poisonous plant halogeton will invade disturbed areas of the salt desert shrub type and result in some livestock losses.

It is anticipated that development of geothermal steam for electrical energy production will produce adverse impacts several times the magnitude of impact from development of non-electrical facilities.

G. Wildlife

While most impacts on wildlife through the exploration phase can be reduced by implementation of mitigating measures, some mortality, displacement, and temporary habitat loss may be unavoidable. Cross-country ORV travel, exploratory road, trail and drill site construction, movement of exploration equipment may cause dislocation of wildlife. Mitigation through habitat rehabilitation cannot be accomplished until facilities are removed. The displacement of animals that are sensitive to man's activities cannot be mitigated until these activities cease.

Any permanent loss of wildlife habitat due to the building of roads, pipelines, transmission lines, energy plants and agri-industrial complexes will be an unavoidable adverse impact. Any act which prevents wildlife from attaining their respective reproductive or recruitment rate is unmitigatable. Disturbance resulting in the abandonment of young, permanent disruption of various food networks, increased traffic related mortatilies and an overall increase in stress resulting from prolonged periods of intrusion all work to prevent the attainment of optimum population levels.

H. Aesthetics

1. Preliminary Exploration

Adverse impacts on aesthetic values, occurring during preliminary exploration, will be greatly lessened or eliminated if properly mitigated.

The potential magnitude of unmitigatable impacts from preliminary exploration on an open-ended (nonsite-specific) project such as this would not be compatible with VRM objective class guidelines for Class II lands. Given a more site specific proposal and the opportunity to prescribe, in the field, a combination of conventional and unconventional methods of implementation, as further mitigating measures, it may be possible to conduct preliminary exploration on certain Class II lands within management guidelines. Providing the recommended mitigating measures are implemented, preliminary exploration would be compatible with management objectives for Class III and IV lands.

2. Exploratory Drilling

Impacts on visual resources would increase over those of preliminary exploration due to increased surface disturbance resulting from road grading, drainage work, drill site development, excavation of mud pits, and construction of new trails and dirt and surfaced roads.

The temporary presence of workers, drill rigs, earth-moving equipment and service vehicles, with the associated dust, noise and night lighting from their operation would be evident during exploratory drilling.

The possible extent of unmitigated impacts resulting from this type of nonsite-specific proposal would not be compatible with VRM objectives for Class II lands. Given a more site-specific proposal and the opportunity to prescribe a combination of conventional and unconventional methods of implementation as further mitigating measures, it may be possible to conduct exploratory drilling on certain Class II lands within management guidelines. Providing the recommended mitigating measures are implemented, exploratory drilling would be compatible on Class III and IV lands.

3. Field Development

Field development would have greater unavoidable impacts on aesthetics. The temporary presence of men, equipment and associated dust, noise and night lighting would be obvious. The long-term visual impacts of surface disturbance and construction of new trails and roads, drill sites, well heads, pipelines, transmission lines, generating plants, and all other attendant facilities could not be entirely mitigated and would be visible in the landscape.

These residual impacts would not be compatible with VRM objective class guidelines for Class II lands, and it is felt that they could not be brought in line with Class II objectives even if given an opportunity for site-specific mitigation. With a more site-specific proposal, it may be possible with a combination of conventional and unconventional mitigating measures to conduct field development in Class III lands within the management guidelines.

Providing the recommended mitigating measures are implemented, field development would be compatible with management objectives for Class IV lands.

4. Production

Most impacts on aesthetic values would already have occurred during previous geothermal activity. The physical aspects of production, the presence of transmission lines and pipelines, plants, etc., would be evident for the life of the project. The long-term visual impacts from excavation and surface disturbance cannot be entirely mitigated and therefore would be visible in the landscape.

These unmitigated impacts would not be compatible with the VRM objective guidelines for Class II lands and could not be brought in line with Class II objectives even with site-specific mitigation. With a more site-specific proposal, it may be possible, through a combination of conventional and unconventional mitigating measures, to conduct production operations on certain Class III lands within management guidelines. Providing the recommended mitigating measures are implemented, production and operation of a geothermal plant and associated facilities would be compatible with management objectives for Class IV lands.

5. Close Out

Generally, activities taking place during close out would be concerned with attempting to return the site to a condition closely approximating the original natural state. Any evidence of the operation left after close out would be detrimental to the natural appearance of the area.

The temporary presence of workers, demolition equipment, earth moving equipment, trucks and miscellaneous service vehicles with the associated dust and noise from their operation would be obvious throughout close out. The visual impacts of surface disturbance and excavation are important due to the extensive area involved and their very long-term nature. These unmitigated impacts would not be compatible with the VRM objective class guidelines for Class II lands. Providing the recommended mitigating measures are implemented, close out would be compatible on Class III and IV lands.

I. Recreation

1. Preliminary Exploration

Unmigitatable impacts from preliminary exploration would have little direct effect on recreation. Activities based upon natural resources, such as vegetation, would be affected as those resources were affected.

2. Exploratory Drilling

The unmitigated impacts of exploration drilling upon recreation values would be similar to, but of greater magnitude and intensity than during preliminary exploration since the level of development activity would increase.

3. Field Development

One of the primary attractions of the area is the wide-open spaces where one can travel relatively unhindered by fences or other man-made obstructions. This wide-open space with few developments also gives rise to another attraction; remoteness from civilization and a chance to be close to nature - wilderness values. Development in any portion of this area would reduce these values in the vicinity of the development. Roads and powerlines would cut large areas into small parcels. A steam generating plant would give surrounding areas an appearance of civilization. Impacts of development on wilderness values cannot be mitigated.

The primary adverse impact on ORV activities would be the loss of area that is occupied by development and the barriers to dirt roads and trails that would result from pipelines or paved roads. Paved roads represent a safety hazard to ORV's and, if heavily used, could be a barrier to motorcycle events. Loss of these areas for recreation use would exist for the life of the project and could not be mitigated during that time.

4. Production

Existing land uses would already have been changed to that of geothermal development. During production and operation, however, the impacts would be of a greater intensity and longer duration, thus affecting many of the recreational uses in the project area.

5. Close Out

Resources which could not be restored to their pre-development condition would be a loss to those recreational activities dependent on them.

J. Archaeological and Historical Resources

While the program of withdrawal of some areas from leasing, recommended non-occupancy, and mitigation will substantially reduce impacts on cultrual resources, two sources of unavoidable impacts are anticipated from geothermal leasing. First, by promoting increased human activity in the area, development may result in intensified vandalism and inadvertant destruction. Second, those sites the impacts upon which are mitigated by salvage operations will suffer information loss due to the limitations of current archaeological technique. Excavation is essentially a destructive process, allowing little or no opportunity to recover at a later date information lost in the original effort. Since archaeological data recovery techniques are constantly being refined, it is inevitable that any site excavated now could be better excavated in the future if it were preserved.

K. Social and Economic Values

1. Preliminary Exploration

There would be no noticeable socioeconomic impacts.

2. Drilling

Drilling and well testing in the vicinity of Wendel could interfere with the residents' sleep in Wendel. This activity in the vicinity of the Wildfowl Management Area would reduce hunting and wildfowl use. Exploration in the parcel adjacent to the Wildlife Management Area could also interfere with its use for agriculture. Approximately 7.5 acres of agricultural land would be directly affected by each exploratory well. Even if the site were abandoned following exploration, this land's productivity would be reduced for several years. The above impacts would also apply to Leasing Unit 10 in The Island area where the surface is in private ownership and the minerals are reserved to the government.

Most of the employment at this stage would go to people from outside of Lassen County. People working in the Wendel-Amedee area would probably be accommodated in existing facilities around Litchfield and Susanville. People working on The Island would stay around Herlong. Since there is little in the way of accommodations for temporary residents available at Herlong, additional trailer hook-ups and homes would be constructed at Herlong to provide space for these people.

Property tax revenues from the exploration activity would constitute 35 to 40 thousand dollars per year to the County and local school districts.

3. Field Development

Power plant development would convert an area which is currently in rangeland uses to industrial uses. Additional housing for construction workers would have to be provided. For the Wendel-Amedee area the housing would be provided by additional motels, mobilehome sites and motels from Litchfield to Susanville. New housing would be expected at Wendel, tending to link Susanville to Wendel by unplanned residential sprawl. Depending upon the location of the development, it could be inconsistent with areas designated as scenic highway corridors or prime recreation areas in the Lassen County General Plan.

Development in areas where the government does not own the surface would result in elimination of on-going agricultural uses of that surface. This ranges from cattle pasture to irrigated alfalfa fields. The release of substances such as H_2S from the geothermal fluids could reduce or eliminate productive agricultural uses of the surrounding area. This development would also reduce the productivity of the Wildfowl Management Area if it were located on Leasing Unit 4. For further discussion on the subject see the Wildlife section.

At the end of the development stage employment would sharply decline. Most of the additional housing, schools and other service facilities assembled for the influx of development employees would be unneeded. Unless there were other development projects following, there would be vacant homes and empty mobilehome spaces.

Property tax revenues would be increasing throughout this period, reaching a peak when the project was completed and operating.

A nonelectrical development could take many forms ranging from heating greenhouses to large food drying facilities. The most likely uses would have much less socioeconomic impact than a power plant during the development stage due to installation in smaller units. Potentially, nonelectrical uses could use the geothermal fluids in an "energy cascade" following a power plant development such as discussed by the City of Susanville (Barmettler, 1976).

4. Production

At the operation stage, 10 to 20 people would be employed full time to operate a 50 to 200 MW power plant. This is much lower employment than during the development stage.

As in the previous stages, the conflicts with the Lassen County General Plan would depend upon the actual plant location. Some locations could conflict with the Plan's scenic highway corridors; locations in the Skedaddle Mountains could conflict with the designation of "prime recreation area."

Operation of a plant near the Wildlife Management Area could interfere with its present use as waterfowl habitat and hunting area. Operation of a plant around Wendel could have occasional periods when sleep interference resulted from well testing. At all of these locations, however, the socio-economic impacts would be a continuation of impacts from the previous stages. The level of impacts would generally be lower than during the development stage.

The greatest property tax revenues to Lassen County and its schools would be derived during the operation stage of the power plant. Using estimates based on The Geysers, California, the annual property tax would be 250 thousand to one million dollars from a 50 to 200 MW plant. The tax revenues would vary with the productivity of the field and the price of electricity.

The operation of a nonelectric development could readily provide more jobs than operation of a power plant. While employment at a power plant would be quite stable, many nonelectrical developments would be seasonal in operation. Property tax revenues from nonelectric developments would generally be lower than a power plant because most are less capital intensive.

5. Close Out

At the closedown stage, all of the equipment would be either removed or deactivated. The property tax revenues would decline to levels compariable to undeveloped sites in the area. The people previously employed in the operation would probably leave the Honey Lake area and seek employment elsewhere. This would be the same pattern of events which followed the closure of the large lumber mill at Westwood, Lassen County, in 1957.

VI. RELATIONSHIP BETWEEN SHORT-TERM USE AND LONG-TERM PRODUCTIVITY

Geothermal resource development implies a change in land use from the present situation toward an industrial complex. The leasing of lands for geothermal resource development will involve the commitment of a portion of the geothermal heat, water, land, and resources of the sites involved over a period of 20 to 50 years. Depending on the extent of the resource, production capacity would be depleted until further operation would not be economically feasible. The leases would then terminate, facilities would be dismantled, and the land restored. The combination of restoration and natural vegetative recovery, over time, should result in a near natural setting. The lands would then return to their former productivity or be available for other appropriate uses.

It is particularly significant to recognize that the geothermal heat is a wasting resource that otherwise would be dissipated over time from the surface of the earth to the atmosphere with little or no identifiable benefit. By contrast, development of this resource in an environmentally acceptable manner can have substantial benefit by affording a relatively clean power generation energy source. While depletion of some of the heat within the geothermal reservoir would occur over a period of operations, no permanent adverse effect is anticipated. Over time, perhaps a hundred or more years, natural heat transfer within the earth might even return the heat content to nearly the same intensity as existed before utilization. At some time in the relatively distant future it might be possible for such areas to again be used for similar productivity. Any use of by-product minerals probably would represent mineral recovery that otherwise would never have occurred. Such use would preclude the need to obtain a like amount of such materials from other sources. Where waste waters are reinjected, the associated mineral values would be returned to the earth.

The generation of power and/or nonelectrical developments (space heating, industrial processes) would be the principal use of geothermal resources. However, use of by-products of water or minerals might be possible, at least at some locations. In terms of total energy requirements, the contribution of geothermal resources may be relatively small but it can be important, particularly on a local basis.

Geothermal fluids also may be of sufficient purity to be used directly for irrigation or other purposes after the fluid has been cooled. This could provide a source of fresh water during the period of power operation and it is possible that the wells could continue to be used even after power production has ended.

Under the proposed controls for waste disposal, degradation of surface and fresh ground waters is not expected to be significant, especially in a long-term sense. Mishaps or accidents may have short-term impacts that, depending upon the volume and nature of discharge involved, could be serious, particularly on aquatic resources. However, corrective measures such as dilution, diversion of waste waters from streams, capturing water in impoundments, etc., should provide adequate measures against serious or long-term impacts. Natural pollution of ground water exists in some areas. Other areas will probably be discovered. The pollution resulting from the upward movement of geothermal fluids into ground water aquifers could be reversed by development of the geothermal resource.

Land uses during the period of production would be changed from wildlife habitat, recreation, grazing, etc., to industrial operations. However, many such uses could continue on a reduced but compatible basis. Wells, pipelines, power plants, by-product facilities, and power transmission facilities would dominate the local area. Public access in the vicinity of such facilities would have to be restricted to protect the public and the facilities. Development and production of geothermal resources generally are not expected to have any lasting or inhibiting effects on the use of the land after geothermal operations have been concluded and the facilities have been removed.

Geothermal resource development could result in certain localized adverse impacts on fish and wildlife and their habitat. There could be a loss of wildlife habitat in the immediate vicinity of installations, minor loss of birds from collision with and/ or electrocution from electric distribution lines, and potential danger to fish and other aquatic life from toxic fluids in the water. In addition, restrictions of public access would reduce hunting and related recreation opportunities in the vicinity of installations. A change in the natural setting of lands could result in long-range effects on wildlife by rendering some lands less desirable for wildlife habitat purposes. Wildlife values probably would reestablish themselves in time after the operations are terminated. In some instances, wildlife may even benefit from this use.

Geothermal development requires substantial investment in drilling wells and construction of roads, pipelines, power and by-product plants, and transmission lines. Such investments result in an increased tax base for the area of development. However, the labor-intensive phase is short-term, occurring primarily during field development, and would not result in significant changes in population distribution. The economic benefits probably would be more in the nature of transfer benefits as a corresponding power generation capacity would have to be developed elsewhere if the geothermal resources were not developed.

There could be some aesthetic or social impacts in terms of increased noise levels, odors, additional traffic, etc., even though all of the environmental stipulations of the permits are met. These would be minor but objectionable in terms of preoperational conditions. Since such operations could continue for a period of 25 to 50 years, they would exist during most of the lifetime of local residents or users of these areas.

Archaeological values will be destroyed by intensive geothermal development if mitigating and enhancement measures are not followed. Continuation of the present situation is also unfavorable to preservation of archaeological values because of steady vandalism by the general public. In some respects the long-term outlook for protection of archaeological values is better if geothermal development occurs because mitigating and enhancing measures would be required.

There would be some aesthetic or visual impacts in terms of increased noise levels, odors, additional traffic, etc., even though all of the environmental stipulations of the permits are met. There would be minor but significant impacts in terms of archaeological significance. These with operations would continue for a period of 25 to 50 years. Loss would exist during each of the dilution of local landfill or waste of space area.

Archaeological values will be destroyed by intensive or phased development of the landfill and treatment facilities are not utilized that instead of the present activities in each university or preservation of archaeological values because of priority operation of the proposed permit. In some respects the long term outlook for preservation of archaeological values in the area is potentially improved because proper excavation and salvaging measures would be employed.

VII. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

Subsidence is not known to have occurred in areas in which geothermal development is taking place. However, the remote possibility for such activity exists, in spite of measures taken to prevent it. The extent to which the process can be halted, if it should begin, is unknown at this time. Thus, subsidence may be considered to some extent an irreversible commitment of the land surface.

Soil formation is a continuing process. However, because such a long period of time is involved in this process, any loss of soil through erosion from exposed surface areas represents an essentially irretrievable commitment of that resource. Alteration of structure or depth of soils can represent an irreversible commitment of that soil to a change in productivity. The extent to which native vegetation is removed and replaced by exotic species represents an irreversible commitment of those areas to new biotic communities. This may result in irretrievable losses to the original wildlife species and possibly to livestock which previously utilized the area. Because fish and wildlife resources cannot be stockpiled for future use in the same manner as timber, the annual production of fish and wildlife resources foregone during the life of the project is irretrievable. Also, the project's adverse effects on fish and wildlife resources and their habitats may not be reversible.

Any loss of cultural or archaeological resources due to any aspect of geothermal development is irretrievable--they cannot be replaced or restored.

The utilization of the geothermal resource constitutes an irretrievable commitment. Although, in theory, the field may recharge itself, the time required is probably too long to consider, in human terms. On the other hand, if the geothermal resources are not committed to power generation, some other source of energy must be used in its place, which in most cases will be presently utilized nonrenewable fossil fuels (i.e., coal, oil and gas, etc.). Therefore, a decision to generate power is, in itself, a commitment of some resource.

VIII. ALTERNATIVES TO THE PROPOSED ACTION

1. No Leasing

There will be no exploration or development of federally owned geothermal resources under this alternative. That portion of the potential geothermal generating capacity and/or potential nonelectrical development capacity applicable to public lands would have to be provided from alternative sources. Potential production of fresh water or mineral by-products also would not materialize. Development of private lands could be even more intensive. Where private lands are adjacent to public lands, geothermal resources of the adjacent public lands could be depleted even though no development took place on the public lands. Surface environmental impacts associated with geothermal exploration and development would not occur if public lands were not leased but problems associated with potential subsurface effects, such as subsidence, could occur as a result of operations on adjacent private lands. The more intensive development of private land resources could result in less orderly and less efficient overall use of geothermal resources of the area.

2. Partial Leasing of Proposed Lease Tracts

Acceptance of this alternative would confine geothermal development to those areas where there are no significant residual adverse impacts. In areas where previously identified significant resource values would be impacted as in areas of recreational or scenic value, archaeologically sensitive areas and wildlife habitat areas, special stipulations and/or determinations for exclusion from leasing will be necessary. Withdrawal of highly sensitive archaeological areas from geothermal leasing may be necessary until potentially valuable archaeological resources within these areas are studied and delineated. Then determinations regarding nomination to the National Register and land-use decisions will be feasible. These actions are in accordance with Executive Order 11593, and Federal policies and orders requiring preservation of the cultural and historic environment of the Nation. Upon reviewing the results of future studies of sensitive archaeological areas, a new EAR or updated supplement to this document could be developed in order to provide a complete analysis of the effects of geothermal leasing in all or portions of the areas.

In some cases, preclusion of portions of vital wildlife habitat areas from concentrated geothermal leasing or plant location is needed to protect significant habitat from deterioration. The degree of habitat deterioration and availability of opportunities for habitat enhancement vary widely and are dependent on the unique relationship between a specific leasing proposal and a specific habitat area.

Likewise, those key recreation use and sensitive viewing areas (see impacts and mitigating measures for aesthetics and recreation) must be considered with other key resource values concerning permanent plant location and supporting facilities. Where key recreation and aesthetic resource values conflict with key development needs and cannot be mitigated through appropriate environmental considerations, determinations must be made for total or partial exclusion of proposed geothermal exploration.

Geothermal exploration on portions of these areas could be allowed under this alternative. Exploratory operations are defined in Proposed Geothermal Resources Operational Order No. 1. Three types of exploration operations are defined in this order: (1) casual use, (2) geophysical exploration and (3) drilling of shallow holes. Sufficient environmental safeguards exist in the terms and conditions of Form 3200-9 (Notice of Intent to Conduct Geothermal Resource Exploration Operations), and in the provisions developed in this EAR to allow casual use and passive geophysical exploration. Surface disturbance does not occur with these operations and the land in these areas is not restricted from other forms of casual use.

Restrictions to ensure adequate environmental safeguards could be placed on surface disturbing operations such as drilling of shallow holes and trail building. Trail building can be restricted to maintenance of existing trails and grading in areas previously disturbed and determined to be free of archaeological resources and sensitive wildlife habitat. Drilling of shallow holes can be restricted to existing roads, trails, and disturbed areas with access. On-site inspection should be performed to insure environmental safeguards before drillsite approval by the Authorized Officer. The effect of this disposition is to restrict surface-disturbing activities to areas of existing disturbance along established corridors and during periods of noncritical wildlife occupancy.

Overview of the Partial Lease Alternatives

The total acres of Federal lands within the two project areas under noncompetitive lease application at this date amounts to 4,963 acres. This does not include potential lease unit 3 which has been either rejected or withdrawn (see TABLE 1). The total Federal land available for competitive lease within the KGRA amounts to 4,487 acres. This includes 320 acres in potential lease unit 4 which is private surface with minerals reserved to the United States under the Stockraising Homestead Act of 1916. The 874 acres of reserved minerals in potential lease unit 10 have not been applied for. The proposed action would allow leasing of all involved public land. On the other hand, the no lease alternative considers all factors of the natural environment and man's environment as overriding the need for the development of energy in the project area.

The three alternatives within the partial lease treatment consider variations in leasable acres from 7,593 acres in the first alternative to about 8,735 acres in the third alternative. This includes 1,194 acres of reserved minerals. While each alternative considers varying constraints on each resource, the basic premise of the partial lease alternatives is that the resources on each tract are within a manageable unit. In reality and within the practical scheme of land management, the complexity of managing a unit is influenced by the proportion of lands under the jurisdiction of the managing agency. Where lower percentages of Federal lands prevail, effective management of many natural resources must be done in coordination with the private land owner, the local board of supervisors and the County planning commission. As additional County planning and direction in developing the geothermal resource on private land become available to the public land managers, it will be incorporated.

Under each partial lease alternative, characteristics and considerations for each resource are outlined. In most cases, only those considerations that would not allow leasing, require no surface occupancy, or not allow permanent structures in certain areas have been listed. Opposite the acreage that is not leaseable, a symbol will identify the particular resource(s) that caused that acreage to be unleaseable. Reference should then be made to the characteristics and considerations particular to that partial lease alternative. In some cases small parcels were not leaseable because buffer zones required to protect certain resources would not allow access to within one-half mile of such parcels. A maximum of one-half mile horizontal "reach" was assumed for directional drilling from leaseable parcels. If a 40 acre parcel was not within one-half mile of leaseable land where surface occupancy was available then this unreachable land was not considered to be developable and therefore not leaseable.

PARTIAL LEASE ALTERNATIVE #2A

Characteristics and Considerations (MAP 28)

1. Wildlife

Waterfowl and Shorebird Habitat

No surface disturbance will be allowed within one-half mile of waterfowl production, brooding, resting, staging, and/or molting areas; or around important wetland habitat where valuable migratory shorebird habitat has been determined to exist.

Birds of Prey (Raptors)

a. No surface disturbance will be allowed within a one-half mile buffer zone around all identified raptor eyries.

b. An additional one-half mile buffer will be established around active raptor eyries between February 1 and September 1 of each year. During the remainder of the year limited surface disturbance will be permitted in the additional one-half buffer with provision that no permanent surface structures other than wells, pipelines and roads shall be constructed.

Upland Game and Small Game

To insure the availability of free water and green vegetation, no surface disturbance shall be permitted within 700 feet of perennial streambeds or 350 feet of intermittent streambeds.

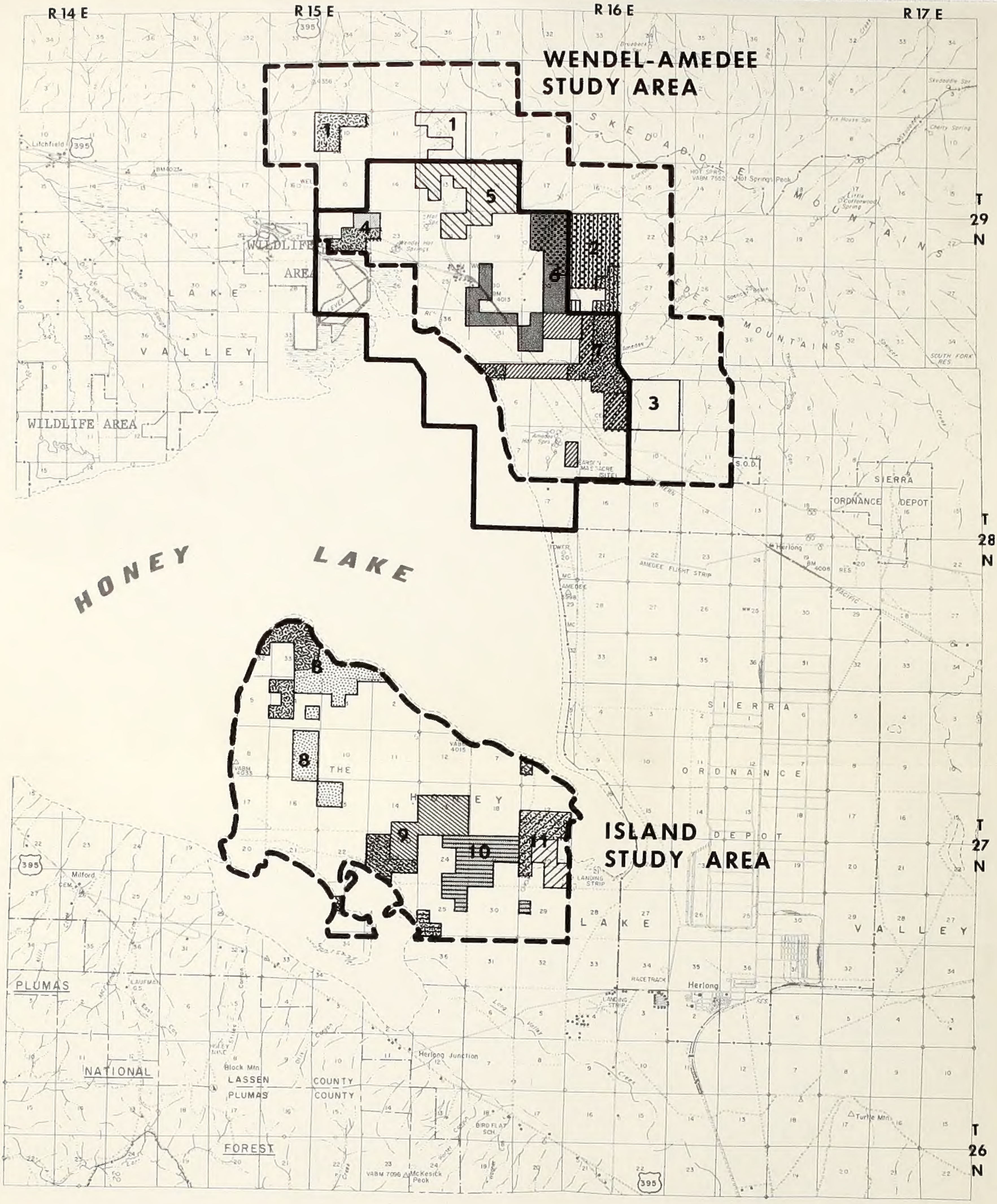
2. Archaeology

No surface occupancy where known sites of National Register quality occur or where avoidance of sites is the most expedient mitigation.

3. Recreation

The decision to lease or not to lease within the boundary of potential wilderness areas identified as Wilderness Study Areas will be deferred until their status as actual wilderness areas is decided by Congress.

Construction of powerplants will be at least one mile from the boundary of the potential wilderness area. All other permanent facilities and structures within this one mile buffer zone will be assessed on a site-specific basis.



LEGEND

- Study Area Boundary
- Wendel-Amedee KGRA Boundary
- 10 Potential Lease Units
- Reserved Minerals (Stockraising Homestead Act of 1916)
- Non-leaseable
- Leaseable
- Defer Decision

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

PARTIAL LEASE ALTERNATIVE 2-A

MAP-28

SCALE: ½" = 1 MILE MT. DIABLO MERIDIAN

4. Aesthetics

Field development and production will not be allowed on Class II visual resource management lands.

5. Soils and Water

No tracts excluded, impacts can be mitigated.

6. Climate, Air, Noise

No tracts excluded, impacts can be mitigated.

7. Vegetation and Livestock

No tracts excluded, impacts can be mitigated.

8. Socio-Economics

No tracts excluded, impacts can be mitigated.

9. Geology

No tracts excluded, impacts can be mitigated.

PARTIAL LEASE ALTERNATIVE 2A

Potential Lease Unit	Location		Leasable	Not Leasable
1	T.29N., R.15E			
CA-1266	Sec. 10: NW¼, N½NE¼, N½SW¼			320 A*
	Sec. 12: N½NW¼, SENW		120	
	Sec. 12: SESW		40	
	Sec. 12: NE¼, NESE, S½SE¼		280	___
		TOTAL	440	320
2	T.29N., R.16E.			
CA-1259	Sec. 28: E½SE, SWSE, S½NE NENE			240 W*
	Sec. 21: E½NE, NESW, S½SW SE			
	Sec. 28: NW¼, NWNE			560 D*
	Sec. 21: NW¼, W½NE, NWSW			280 D*
	Sec. 28: SWSW		40	___
		TOTAL	40	1080
3 CA-1261	This noncompetitive lease application has been partially rejected and the remainder has been withdrawn. There will be no further administrative action at this time.			
4	This potential lease unit covers 320 acres of reserved minerals.			
	T.29N., R.15E.			
	Sec. 22: S½NE¼, NESW, N½SE¼			
	Sec. 23: SWNW			240 W*
	Sec. 23: NWNW		40	
	Sec. 22: NENE		40	___
		TOTAL	80	240

* A-Archaeology; W-Wildlife; D-Defer Decision

Potential Lease Unit	Location	Leasable	Not Leasable
5	T.29N. R.15E.		
	Sec. 13: SWNW, NESW		
	Sec. 24: NE¼		
	T.29N., R.16E.		
	Sec. 18: S½SE		
	Sec. 19: Lot 1, NENW	400	
	T.29N., R.15E.		
	Sec. 13: NWNW	40	
	T.29N., R.16E.		
	Sec. 18: Lots 1-4, E½W½, N½SE, NE¼	565	
	T.29N., R.15E.		
	Sec. 13: E½NW¼, N½NE, SENE	200	
	TOTAL	1205	
6	T.29N., R.16E.		
	Sec. 29: SENE, E½SE	120	
	Sec. 20: E½NE, SWNE, SE¼		
	Sec. 29: NENE		320 D*
	Sec. 29: NWNE, SWNE, W½SE		
	Sec. 32: E½NW	240	
	Sec. 31: NWNE, NENW		
	Sec. 32: NWSW	120	
	Sec. 20: NWNE, E½NW, NESW		160 D*
	Sec. 30: E½NW, N½SW, SWSW		
	Sec. 31: NWNW, NENE		
	Sec. 32: SWNW, NESW	362	
	TOTAL	842	480

* A-Archaeology; W-Wildlife; D-Defer Decision

Potential Lease Unit Leasable	Location	Leasable	Not
7	T.29N., R.16E.		
	Sec. 33: E½		
	All public land in hiatus that lies above Sec. 4 and E½E½ of public land in hiatus that lies north of Sec. 5, and W½ of public land north of Sec. 6,		
	T.28N., R.16E.		
	Sec. 4: Lots 1-3		680 A, W*
	Sec. 32: NENE		
	Sec. 33: W½NW	120	
	Sec. 33: E½W½		
	T.28N., R.16E.		
	Sec. 4: S½NE, N½SE		320 D*
	Sec. 32: W½NE, SENE		
	T.28N., R.16E.		
	Sec. 4: SWSE	160	
	Sec. 4: SESE	40	
	Sec. 8: SENE, NESE	80	
	T.28N., R.16E., W½E½ and W½ of public land in hiatus that lies north of Sec. 5, and E½ of public land that lies north of Sec. 6.	200	
	TOTAL	600	1000
8 CA-1052	T.28N., R15E.		
	Sec. 33: Lots 1-4		
	Sec. 32: Lot 1		
	T.27N., R.15E.		
	Sec. 4: Lots 3, 4, N½SW¼, SENW		339 A*
	T.28N., R.15E.		
	Sec. 33: Lot 5		
	Sec. 34: Lots 1-3		
	Sec. 35: Lot 1		

* A-Archaeology; W-Wildlife; D-Defer Decision

Potential Lease Unit	Location	Leasable	Not Leasable
8 (Continued)	T.27N., R.15E.		
	Sec. 4: Lots 1, 2, NESE		
	Sec. 15: NW¼	352	
	T.27N., R.15E.		
	Sec. 3: Lots 2-4, SENW		
	Sec. 9: E½	480	___
	TOTAL	832	339
9	T.27N., R.15E.		
CA-1051	Sec. 23: Lots 1,2, NW¼, N½SE¼		
	Sec. 27: Lot 6		335.5 W&A*
	(Sec. 25: Lots 1,3)		(53) W*
	Sec. 14: S½SE¼		
	Sec. 23: NE¼	240	
	Sec. 13: S½N½, S½	480	_____
	TOTAL	720	389
10	This potential lease unit covers 874 acres of reserved minerals.		
	T.27N., R.15E.		
	Sec. 24: E½NE¼, NWNE, E½SE¼, SWSE		
	Sec. 25: N½NE, SENE		
	T.27N., R.16E.		
	Sec. 19: Lots 1-4, NE¼, E½NW¼, E½SW¼		
	Sec. 29: SWNW	874	
	TOTAL	874	
11	T.27N., R.16E.		
CA-1027	Sec. 8: Lot 7		
	Sec. 17: S½		
	Sec. 20: W½NW¼, NWSW		483 A*
	Sec. 20: E½NW¼, W½NE¼, NWSE	200	
	Sec. [illegible]: E½SE¼, SWSE	120	___
	TOTAL	320	483

* A-Archaeology; W-Wildlife; D-Defer Decision

Characteristics and Considerations (MAP 29)

1. Wildlife

Waterfowl and Shorebird Habitat

a. No surface disturbance will be allowed within one-half mile of waterfowl management areas (Fleming Unit).

b. No surface disturbance will be allowed within one-fourth mile of waterfowl production, brooding, resting, staging, and/or molting areas, or around important wetland habitat where valuable migratory shorebird habitat has been determined to exist.

Birds of Prey (Raptors)

a. No surface disturbance will be allowed within a one-half mile buffer zone around all identified raptor eyries.

b. An additional one-half mile buffer will be established around active raptor eyries in which no permanent structures other than wells, pipelines and roads will be allowed.

Upland Game and Small Game

To assure the availability of free water and green vegetation, no surface disturbance shall be permitted within 700 feet of permanent streambeds or 350 feet of intermittent streambeds.

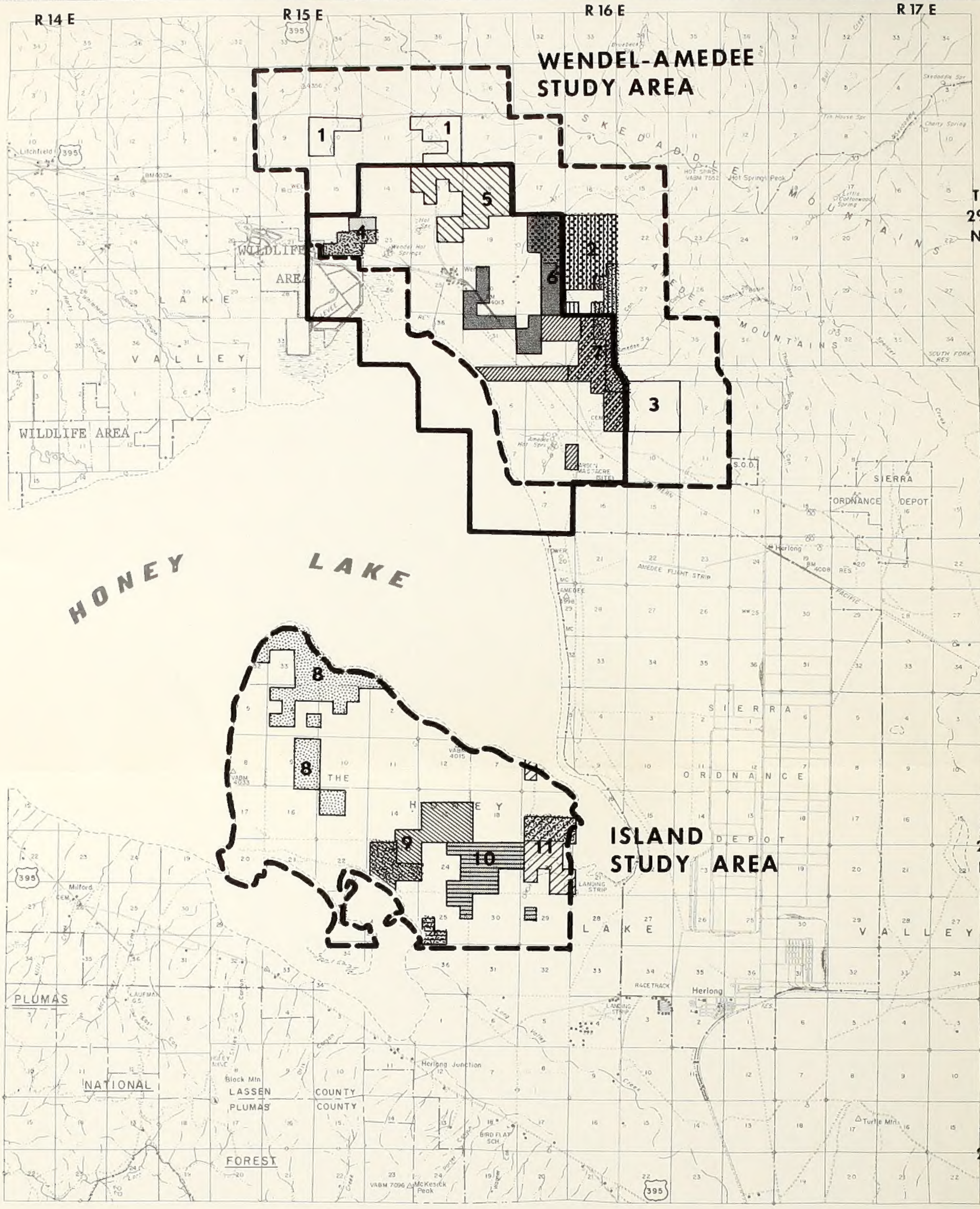
2. Archaeology

No surface occupancy where known sites of National Register Quality occur. (Section 18 will cover the rest.)

3. Recreation

The decision to lease or not to lease within the boundary of potential wilderness areas identified as Wilderness Study Areas will be deferred until their status as actual wilderness is decided by Congress.

Construction of power plants will be at least one mile from the boundary of the potential wilderness area. All other permanent facilities and structures within this one mile buffer zone will be assessed on a site-specific basis.



LEGEND

Study Area Boundary

Wendel-Amedee KGRA Boundary

10 Potential Lease Units

Reserved Minerals (Stockraising Homestead Act of 1916)

Non-leaseable

Leaseable

Defer Decision

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

PARTIAL LEASE ALTERNATIVE 2-B

MAP-29

SCALE: ½" = 1 MILE MT. DIABLO MERIDIAN

4. Aesthetics

Field development and production will be allowed on Class II visual resource management lands.

5. Soils and Water

No tracts excluded, impacts can be mitigated.

6. Climate, Air, Noise

No tracts excluded, impacts can be mitigated.

7. Vegetation and Livestock

No tracts excluded, impacts can be mitigated.

8. Socio-Economics

No tracts excluded, impacts can be mitigated.

9. Geology

No tracts excluded, impacts can be mitigated.

PARTIAL LEASE ALTERNATIVE 2B

Potential Lease Unit	Location	Leasable	Not Leasable
1	T.29N., R.15E.		
CA-1266	Sec. 10: S½NW, N½SW	160	
	Sec. 10: N½N½	160	
	Sec. 12: SESW	40	
	Sec. 12: NE, NESE, S½SE, N½NW, SENW	400	
	TOTAL	760	
2	T.29N., R.16E.		
CA-1259	Sec. 21: E½, NESW, S½SW		
	Sec. 28: NW¼, NWNE		640 D*
	Sec. 28: SWSW	40	
	Sec. 28: E½E½, SWNE, SWSE		240 W*
	Sec. 21: NW¼, NWSW		200 D*
	TOTAL	40	1080
3	This noncompetitive lease application has been partially rejected and the remainder has been withdrawn. There will be no further administrative action at this time.		
CA-1261			
4	This potential lease unit covers 320 acres of reserved minerals.		
	T.29N., R.15E.		
	Sec. 22: S½NE, NESW, N½SE		
	Sec. 23: SWNW		240 W*
	Sec. 23: NWNW		
	Sec. 22: NENE	80	
	TOTAL	80	240

* A-Archaeology; W-Wildlife; D-Defer Decision

PARTIAL LEASE ALTERNATIVE 2B (Continued)

Potential Lease Unit	Location	Leasable	Not Leasable
5	T.29N., R.15E.		
	Sec. 24: NE¼		
	T.29N., R.16E.		
	Sec. 19: N½NW	240	
	T.29N., R.15E.		
	Sec. 13: NWNW	40	
	Sec. 13: SWNW, NESW, E½NW, N½NE, SENE		
	T.29N., R.16E.		
	Sec. 18: Lots 1-4, E½W½, E½	925	
	TOTAL	1205	
6	T.29N., R.16E.		
	Sec. 29: SENE, E½SE	120	
	Sec. 20: E½NE, SWNE, SE¼		
	Sec. 29: NENE		320 D*
	Sec. 29: W½E½		
	Sec. 32: E½NW	240	
	Sec. 20: NWNE, E½NW, NESW		160 D*
	Sec. 30: E½NW, N½SW, SWSW		
	Sec. 31: N½N½		
	Sec. 32: N½SW, SWNW	480	
	TOTAL	840	480
7	T.29N., R.16E.		
	Sec. 33: NE¼, E½SE		
	E½ of public land in hiatus that lies north of Sec. 4,		
	T.28N., R.16E.		
	Sec. 4: Lot 1, 2		400 W*

* A-Archaeology; W-Wildlife; D-Defer Decision

Potential Lease Unit	Location	Leasable	Not Leasable
7 (Continued)	T.29N., R.16E. Sec. 33: E½NW, E½SW, W½SE W½ of public land in hiatus that lies north of Sec. 4, T.28N., R.16E. Sec. 4: Lot 3, S½NE, N½SE		520 D*
	T.29N. R.16E. Sec. 32: NENE Sec. 33: W½NW	120	
	E½E½ of public land in hiatus that lies north of Sec. 5, T.28N., R.16E. Sec. 4: S½SE		120 D*
	T.29N., R.16E Sec. 32: W½NE, SENE W½E½ of public land in hiatus that lies north of Sec. 5, T.28N., R.16E.	160	
	W½ of public land in hiatus that lies north of Sec. 5, and all public land in hiatus that lies north of Sec. 6, T.28N., R.16E. Sec. 8: SENE, NESE	280	
	TOTAL	560	1040
8 CA-1052	T.27N., R.15E. Sec. 3: Lots 2-4, SENW Sec. 4: Lots 1-4, N½SW, SENW, NESE Sec. 9: E½ Sec. 15: NW¼ T.28N., R.15E. Sec. 32: Lot 1 Sec. 33: Lots 1-5 Sec. 34: Lots 1-3 Sec. 35: Lot 1	1171	
	TOTAL	1171	

*A-Archaeology; W-Wildlife; D-Defer Decision

PARTIAL LEASE ALTERNATIVE 2B (Continued)

Potential Lease Unit	Location		Leasable	Not Leasable
9 CA-1051	T.27N., R.15E. Sec. 23: Lot 1,2, NW¼, N½SE Sec. 27: Lot 6 Sec. 25: Lots 1, 3 Sec. 14: S½SE			389 A*
	Sec. 23: NE¼		240	
	Sec. 13: S½N½, S½		480	
		TOTAL	720	389
10 Reserved Minerals	T.27N., R.15E. Sec. 24: E½NE, NWNE, E½SE, SWSE Sec. 25: N½NE, SENE T.27N., R.16E. Sec. 19: Lots 1-4, NE¼, E½W½ Sec. 29: SWNW		874	
		TOTAL	874	
11 CA-1027	T.27N., R.16E. Sec. 17: S½ Sec. 8: Lot 7			320 A*
	Sec. 20: W½NE, NW¼, NWSW, SE¼		483	
		TOTAL	483	320

* A-Archaeology; W-Wildlife; D-Defer Decision

Characteristics and Considerations (MAP 30)

1. Wildlife

Waterfowl and Shorebird Habitat

a. No surface disturbance will be allowed within one-half mile of waterfowl management areas.

b. No surface disturbance will be allowed within one-eighth mile of waterfowl production, brooding, nesting, staging and/or molting areas; or around important wetland habitat where valuable migratory shorebird habitat has been determined to exist.

Birds of Prey (Raptors)

a. No surface distrubance will be allowed within a one-half mile buffer zone around all identified raptor eyries.

b. An additional one-fourth mile buffer zone will be established around active raptor eyries in which no permanent structures other than wells, pipelines and roads will be allowed.

Upland Game and Small Game

To assure the availability of free water and green vegetation, no surface disturbance shall be permitted within 700 feet of permanent streambeds or 350 feet of intermittent streambeds.

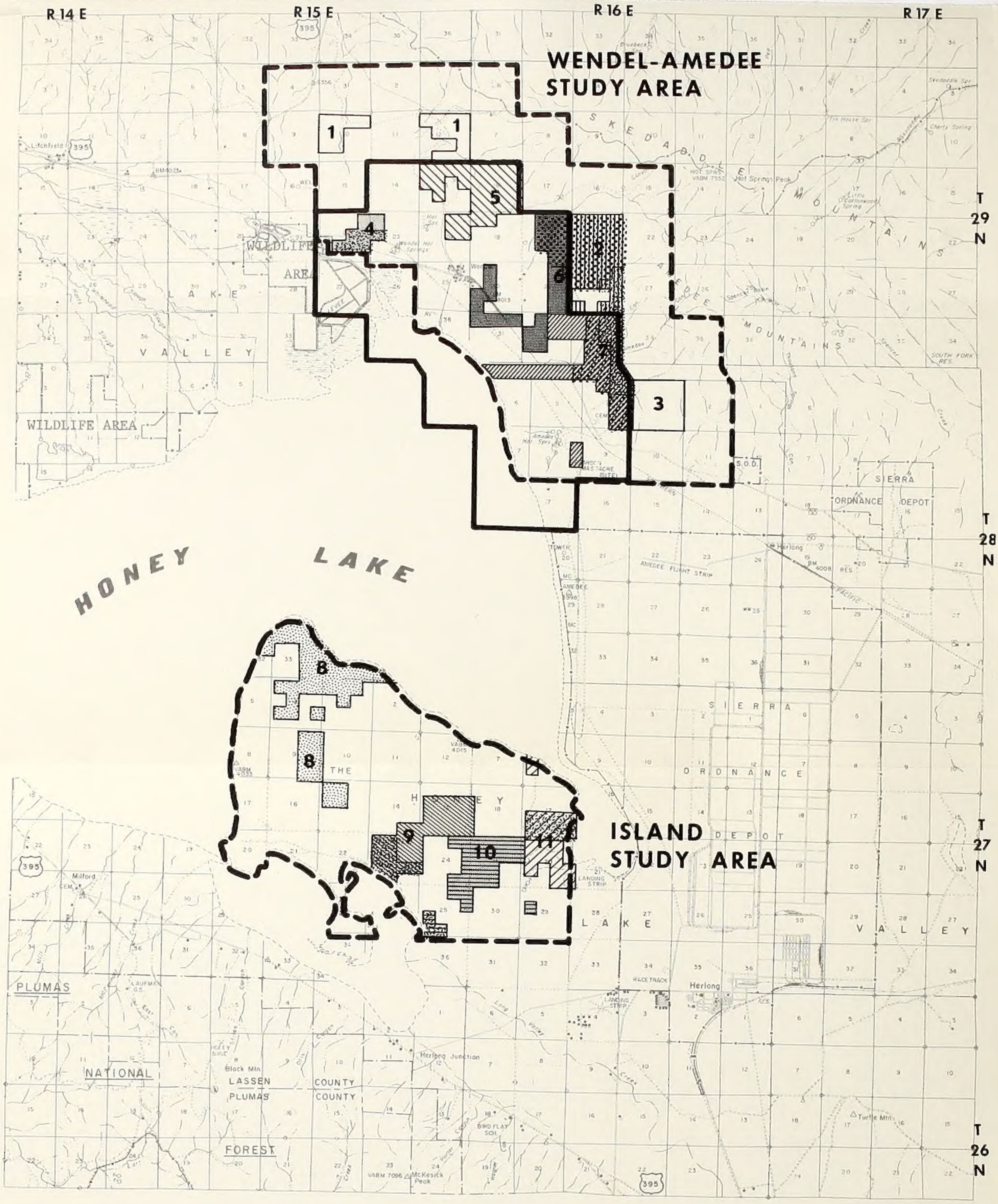
2. Archaeology

No surface occupancy where known sites of National Register Quality occur (Section 18 covers the rest).

3. Recreation

The decision to lease or not to lease within the boundary of potential wilderness areas identified as Wilderness Study Areas will be deferred until their status as actual wilderness is decided by Congress.

Construction of power plants will be at least one mile from the boundary of the potential wilderness area. All other permanent facilities and structures within this one mile buffer zone will be assessed on a site-specific basis.



LEGEND

Study Area Boundary

Wendel-Amedee KGRA Boundary

10 Potential Lease Units

Reserved Minerals (Stockraising Homestead Act of 1916)

Non-leaseable

Leaseable

Defer Decision

HONEY LAKE VALLEY
GEOTHERMAL STUDY AREA

PARTIAL LEASE ALTERNATIVE 2-C

MAP-30

SCALE: ½" = 1 MILE   MT. DIABLO MERIDIAN

4. Aesthetics

Field development and production will be allowed on Class II visual resource management lands.

5. Soils and Water

No tracts excluded, impacts can be mitigated.

6. Climate, Air, Noise

No tracts excluded, impacts can be mitigated.

7. Vegetation and Livestock

No tracts excluded, impacts can be mitigated.

8. Socio-Economics

No tracts excluded, impacts can be mitigated.

9. Geology

No tracts excluded, impacts can be mitigated.

PARTIAL LEASE ALTERNATIVE 2C

Potential Lease Unit	Location	Leaseable	Not Leaseable
1	T.29N., R.15E.		
CA-1266	Sec. 10: S½NW, N½SW	160	
	Sec. 10: N½NE		
	Sec. 12: N½NW, SENW, SWNE, SWSE	280	
	Sec. 10: N½NW		
	Sec. 12: E½E½, NWNE	280	
	Sec. 12: SESW	40	
	TOTAL	760	
2	T.29N., R.16E.		
	Sec. 28: E½E½, SWNE, SWSE		240 W*
	Sec. 21: E½NE, NESW, S½SW, SE¼		
	Sec. 28: NW¼, NWNE		560 D*
	Sec. 28: SWSW	40	
	Sec. 21: S½NW, W½NE, NWSW, NENW		240 D*
	Sec. 21: NWNW		40 D*
	TOTAL	40	1080
3	This noncompetitive lease application has been partially rejected and the remainder has been withdrawn. There will be no further administrative action at this time.		
CA-1261			
4	This potential lease unit covers 320 acres of reserved minerals.		
	T.29N., R.15E.		
	Sec. 22: S½NE, NESW, N½SE		
	Sec. 23: SWNW		240 W*
	Sec. 23: NWNW		
	Sec. 22: NENE	80	
	TOTAL	80	240

* A-Archaeology; W-Wildlife; D-Defer Decision

PARTIAL LEASE ALTERNATIVE 2C (Continued)

Potential Lease Unit	Location	Leasable	Not Leasable
5	T.29N., R.15E.		
	Sec. 24: NE¼		
	T.29N., R.16E.		
	Sec. 19: N½NW	240	
	T.29N., R.15E.		
	Sec. 13:NWNW	40	
	Sec. 13: E½NW, SWNW, NWNE	160	
	Sec. 13: NESW, E½NE		
	Sec. 18: Lots 1-4, E½W½, E½	765	
	TOTAL	1205	
6	T.29N., R.16E.		
	Sec. 29: SENE, E½SE	120	
	Sec. 20: E½SE		
	Sec. 29 NENE		120 D*
	Sec. 29: NWNE, SWNE, W½SE	160	
	Sec. 20: NE¼, E½NW, W½SE, NESW		360 D*
	Sec. 30: E½NW, N½SW, SWSW		
	Sec. 31: N½N½		
	Sec. 32: E½NW, N½SW, SWNW	562	
	TOTAL	842	480
7	T.29N., R.16E		
	Sec. 33: NE¼, E½SE		
	E½ of public land in hiatus that lies north of Sec. 4,		
	T.28N., R.16E.		
	Sec. 4: Lot 1, 2		400 W*

* A-Archaeology; W-Wildlife; D-Defer Decision

Potential Lease Unit	Location	Leasable	Not Leasable
7 (Continued)	T.29N., R.16E.		
	Sec. 33: E½NW, E½SW, W½SE		
	W½ of public land in hiatus that lies north of Sec. 4,		
	T.28N., R.16E.		
	Sec. 4: Lot 3, S½NE, N½SE		520 D*
	T.29N., R.16E.		
	Sec. 32: NENE		
	Sec. 33: W½NW	120	
	E½E½ of public land in hiatus that lies north of Sec. 5,		
	T.28N., R.16E.		
	Sec. 4: S½SE		120 D*
	T.29N., R.16E.		
	Sec. 32: W½NE, SENE		
	W½E½ of public land in hiatus that lies north of Sec. 5,		
	T.28N., R.16E.	160	
	W½ of public land in hiatus that lies north of Sec. 5 and all public land in hiatus that lies north of Sec. 6, T.28N., R.16E.		
	Sec. 8: SENE, NESE	280	___
	TOTAL	560	1040
8 CA-1052	T.27N., R.15E.		
	Sec. 3: Lots 2-4, SENW		
	Sec. 4: Lots 1-4, N½SW, SENW, NESE		
	Sec. 9: E½		
	Sec. 15: NW¼		
	T.28N., R.15E.		
	Sec. 32: Lot 1		
	Sec. 33: Lots 1-5		
	Sec. 34: Lots 1-3		
	Sec. 35: Lot 1	1171	
	TOTAL	1171	

*A-Archaeology; W-Wildlife; D-Defer Decision

Potential Lease Unit	Location		Leasable	Not Leasable
9	T.27N., R.15E.			
CA-1051	Sec. 23: Lot 1,2, NW¼, N½SE			
	Sec. 27: Lot 6			
	Sec. 25: Lots 1, 3			389 A*
	Sec. 14: S½SE			
	Sec. 23: NE¼		240	
	Sec. 13: S½N½, S½		480	
		TOTAL	720	389
10	T.27N., R.15E.			
Reserved	Sec. 24: E½NE, NWNE, E½SE			
Minerals	SWSE			
	Sec. 25: N½NE, SENE			
	T.27N., R.16E.			
	Sec. 19: Lots 1-4, NE¼, E½W½			
	Sec. 29: SWNW		874	
		TOTAL	874	
11	T.27N., R.16E.			
CA-1027	Sec. 17: S½			320 A*
	Sec. 8: Lot 7			
	Sec. 20: W½NE, NW¼, NWSW, SE¼		483	
		TOTAL	483	320

* A-Archaeology; W-Wildlife; D-Defer Decision

IX. PERSONS, GROUPS AND GOVERNMENT AGENCIES CONSULTED

The following steps will serve as a chronological listing of events which include an up-to-date summary of persons, groups, and agencies consulted.

1) The Preparation Plan for the Environmental Analysis Record on the Honey Lake Valley Geothermal Project was submitted to the California State Office on April 12, 1976. The proposed project was outlined and team members designated.

2) Although some prior correspondence with other agencies and groups had provided notification of the project, on April 13, 1976, an official Notice of Intent was filed with the State Clearinghouse. In addition, a letter that identified the study area boundaries and requested information for the environmental analysis was sent to all Federal, State, and local agencies, and private interest groups who might have any related interest in the project. A listing of these various agencies and groups which were contacted is presented in the following pages. Also included on the mailing list are requests from individuals and corporations that have expressed interest in Honey Lake Valley geothermal resources in telephone conversations.

3) The initial team coordination meeting occurred on April 28, 1976, at the Susanville District Office in Susanville. Basically, this meeting accomplished development of an outline of the environmental analysis format, assignment of team member responsibilities, data needs and sources, timeframe and schedule conflicts, and a review of various agency coordination steps.

4) A presentation was given to the following to inform them of the Bureau's intention to initiate a comprehensive Environmental Analysis Record for the Wendel-Amedee and Island Areas. The areas were outlined and timeframe for completion of the document given. All were assured that they would be kept informed on all developments with this project:

April 19, 1976	Mark Totten, Lassen County Planning Commission
April 20, 1976	Jim Jeskey, Susanville City Finance Director
April 29, 1976	Lassen County Board of Supervisors

5) On April 28, 1976, a public meeting was held in Susanville to discuss the subject EAR and to encourage public involvement. In addition to providing an orientation to the proposed project, it was hoped that more or better information would be obtained from persons or groups in attendance and to obtain a clear understanding of the public views concerning the proposed action. An opportunity to receive agency or group positions and questions by the general public was provided. Persons in attendance seemed interested in the presentations and exchanged information freely. A copy of the letter which was mailed out to various agencies and individuals prior to the meeting and related radio and newspaper coverage announcing the meeting are shown in APPENDICES 9 and 10, respectively.

6) An MFP (Management Framework Plan) public meeting was held June 21, 1976, which discussed multiple land-use proposals for the Honey Lake Planning Unit. This meeting was held in Susanville, California at the Conference Room of the Eagle Lake Ranger District, Lassen National Forest Service.

7) Designated members of the team attended the Susanville Geothermal Energy Conference held July 14-15-16, 1976, at Lassen College, Susanville, California. Although the agenda for the conference was very broad it did provide the opportunity to acquaint attendees with the proposed project during one of the workshop sessions. Information obtained from the workshop was deemed very heldful in preparing portions of this report.

8) A briefing on the status of the EAR was presented on October 13, 1976, to the Susanville District Multiple-Use Advisory Board at Cal-Pines Lodge, Alturas, California.

This is a composite of events which highlight consultation activities with various agencies and groups concerning the subject EAR prior to publication.

The Draft EAR was submitted for public review in June and July, 1977. Comments on the Draft and BLM response of these comments are provided in Chapter X.

FEDERAL AGENCIES

Lassen National Forest
707 Nevada Street
Susanville, CA 96130

U.S. Bureau of Mines
Western Field Operations Center
West 222 Mission Avenue
Spokane, Washington 99201

National Park Service
Western Region
450 Golden Gate Ave.
Box 36063
San Francisco, CA 94102

Soil Conservation Service
50 Hall Street
P. O. Box 568
Susanville, CA 96130

Soil Conservation Service
State Conservationist
P. O. Box 1019
Davis, CA 95616

North Cal-Neva RC & D
USDA, Soil Conservation Service
P. O. Box 888
Alturas, CA 96101

U.S. Corps of Engineers
District Engineer
650 Capitol Mall
Room 6112
Sacramento, CA 95814

U.S. Bureau of Mines
Federal Bldg., Room 306
705 N. Plaza Street
Carson City, Nevada 89701

Bureau of Reclamation
Department of the Interior
Regional Director
2800 Cottage Way
Sacramento, CA 95825

FEDERAL AGENCIES (Continued)

Bureau of Fish & Wildlife
Department of the Interior
Division of Wildlife Services
2800 Cottage Way
Sacramento, CA 95814

River Basin Studies
Field Supervisor
2800 Cottage Way
Sacramento, CA 95825

Bureau of Outdoor Recreation
Department of Interior
Regional Director
450 Golden Gate Avenue
Box 36062
San Francisco, CA 94102

U.S. Geological Survey
Conservation Division
Regional Hydraulic Engineer
2800 Cottage Way
Sacramento, CA 95825

U.S. Geological Survey
Office of Minerals Exploration
300 North Los Angeles
Los Angeles, CA 90012

U.S. Geological Survey
Water Resources Division
Subdistrict Chief
3251 "S" Street
Sacramento, CA 95814

Sierra Army Depot
Commanding Officer
Herlong, CA 96114

U.S. Geological Survey
Assistant Director
Conservation Division
345 Middlefield Road
Menlo Park, CA 94025

FEDERAL AGENCIES (Continued)

U.S. Geological Survey
Conservation Division
District Geothermal Office
62 Keystone Avenue
Reno, Nevada 89502

Bureau of Land Management
Building 50 (D-310)
Denver Federal Center
Denver, Colorado 80225
Attn: Theodore W. Holland

ADVISORY BOARD REPRESENTATIVES

John Laxague
Cedarville, CA 96104

Robert Flournoy
Likely CA 96116

Frank Hagata
P. O. Box 71
Susanville, CA 96130

Gary Shaffer
1060 Cherry Terrace
Susanville, CA 96130

Andrew S. Burnett
426 Rock Boulevard
Sparks, Nevada 89431

Wayne N. Capurro
5334 Valley Vista Drive
Sparks, Nevada 89431

Mark Totten
Courthouse Annex, Room 103
Susanville, CA 96130

Robert Gordon Colwell
Division of Engineering
California State University, Chico
Chico, CA 95929

STATE AGENCIES

Copies for the following agencies are sent to the State Clearinghouse.

Office of the Governor
Office of Planning and Research
State Clearinghouse
1400 10th Street
Sacramento, CA 95814

Park and Recreation Specialist
Grants & Statewide Studies Branch
California Dept. of Parks & Recreation
P. O. Box 2390
Sasramento, CA 95811

California Regional Water Quality
Control Board
Lahontan Region
Executive Officer
1014 Blue Lake Avenue
P. O. Box 14367
South Lake Tahoe, CA 95705

Division of Mines and Geology
Second Floor
Ferry Building
San Francisco, CA 94111

Division of Soil Conservation
1416 Ninth Street
Sacramento, CA 95814

State Lands Commission
1807 13th Street
Sacramento, CA 95814

Division of Highways
State Engineer
1120 N. Street
Sacramento, CA 95814

Resource Agency of California
1416 Ninth Street
Sacramento, CA 95814

Department of Water Resources
1416 Ninth Street
Sacramento, CA 95814

STATE AGENCIES (Continued)

Department of Parks & Recreation
1416 Ninth Street
Sacramento, CA 95814

Department of Fish & Game
1416 Ninth Street
Sacramento, CA 95814

Department of Conservation
1416 Ninth Street
Sacramento, CA 95814

Division of Forestry
1416 Ninth Street
Sacramento, CA 95814

Energy Assessment Division
California Energy Commission
1111 Howe Avenue
Sacramento, CA 95825

Copies of the following agencies are individually addressed.

Wildlife Conservation Board
1416 Ninth Street
Sacramento, CA 95814

State of California
Division of Forestry
State Forest Ranger
Westwood Road
Susanville, CA 96130

Department of Fish & Game
Ken Conrad
1501 North Street
Susanville, CA 96130

Department of Fish & Game
Doug Thayer
Alturas, CA 96101

Department of Fish & Game
Bob Weld
Honey Lake Refuge
c/o Fleming Unit
Wendel, CA 96136

STATE AGENCIES (Continued)

Department of Fish & Game
627 W. Cypress Avenue
Redding, CA 96001

STATE AGENCIES - NEVADA

Nevada Department of
Conservation & Natural Resources
201 S Fall
Carson City, Nevada

Nevada State Deparment
of Agriculture
350 Capitol Hill Avenue
Reno, Nevada 89502

State of Nevada
State Planning Coordinator
State Capitol Building, Room 45
Carson City, Nevada 89710

Desert Research Institute
University of Nevada
Dr. Don D. Fowler, Archaeologist
Reno, Nevada 89502

Director, Nevada State Museum
600 N. Carson
Carson City, Nevada 89701

John Richardson
Chief, Recreation Land Use Planner
Nevada State Parks
Room 221, Nye Building
Carson City, Nevada 89701

Wilbur Wieprecht
Historic Preservation Specialist
Nevada State Parks
Room 221, Nye Building
Carson City, Nevada 89701

Nevada State Parks
Room 221, Nye Building
201 S. Fall Street
Carson City, Nevada 89710

STATE AGENCIES - NEVADA (Continued)

State of Nevada
Department of Fish & Game
1100 Valley Road
P. O. Box 10678
Reno, Nevada 89510

State of Nevada, Region I
Department of Fish & Game
P. O. Box
Fallon, Nevada 89406

COUNTY GOVERNMENTS & CITY AGENCIES

League of California Cities
Richard Carpenter, Executive Director
and General Counsel
Hotel Claremont
Berkeley, CA 94705

Lassen County Board of Supervisors
Courthouse
Susanville, CA 96130

Lassen County Planning Commission
Mark Totten
Courthouse
Susanville, CA 96130

Lassen County Agriculture Commissioner
175 Russell
Susanville, CA 96130

Lassen County Agricultural
Extension Agent
Memorial Building
Carl Rimbey
Les Allen
Susanville, CA 96130

Lassen County Road Commissioner
Courthouse Annex
Susanville, CA 96130

City of Susanville
Jim Jesky, Finance Director
Susanville, CA 96130

COUNTY GOVERNMENTS & CITY AGENCIES (Continued)

Lassen County Air Pollution Board
175 Russell Avenue
Susanville, CA 96130

Lassen County Water Resources Board
Susanville, CA 96130

Susanville Planning Commission
66 N. Lassen Street
Susanville, CA 96130

Alice T. Dresel, Executive Officer
Local Agency Formation Commission
P. O. Box 1088
Susanville, CA 96130

Modoc County
Board of Supervisors
Courthouse
Alturas, CA 96101

Modoc County Department
of Public Works
Jerry Grove
202 W. 4th
Alturas, CA 96101

Washoe County Commissioners
1205 Mill Street
Reno, Nevada 89502

Washoe County Parks and Recreation
Department
Charles W. Gale, Director
P. O. Box 11130
Reno, Nevada 89510

Regional Planning Commission
Attn: Steve Bradhurst
P. O. Box 1286
Reno, Nevada 89504

Lassen County Library
Courthouse Annex
Susanville, CA 96130

Modoc County Library
212 W. 3rd Street
Alturas, CA 96101

SPECIAL INTEREST GROUPS

Environmental, Conservation Interests

Sierra Club
Michael McCloskey
530 Bush Street
San Francisco, CA 94104

Sierra Club
255 Urusuline Road
Santa Rosa, CA 95401

Sierra Club - Toiyabe Chapter
Northern California Regional
Conservation Committee
720 Brookfield Drive
Reno, Nevada 89503

Sierra Club - Toiyabe Chapter
Dave Boroughf, Conservation Chairman
208 Vassar Street
Reno, Nevada 89502

Scientific Resource Surveys, Inc.
Roger J. Desantels, President
2192 Puenta Street
Costa Mesa, CA 92627

California Natural Resources Federation
2775 Cottage Way, Suite 39
Sacramento, CA 95825

Jerry Meral
Environmental Defense Fund
2728 Durant Avenue
Berkeley, CA 94704

Clyde E. Kuhn
2207 Carroll Street, Apt. 3
Oakland, CA 94606

Ecoview
2540 Trower Avenue
Napa, CA 94558

Ecology Information Center
1917-A 16th Street
Sacrament, CA 95814

Friends of the Earth, Inc.
529 Commercial Street
San Francisco, CA 94111

Historical and Archaeological Interests

Thomas Hunt
Committee for the Emigrant-Bicentennial
National Monument
950 Old Trace Road
Palo Alto, CA 94306

Trails West Inc.
Cedarville, CA 96104

Lassen County Historical Society
Susanville, CA 96130

Lassen County Heritage Society
Bernice Hagata, President
P. O. Box 71
Susanville, CA 96130

Livestock Interests

Lassen County Cattlemen's Association
Bud Price, President
Susanville, CA 96130

California Cattlemen's Association
Bill Staiger
Senator Hotel
12th and L Street
Sacramento, CA 95814

Public Lands Committee
Jack Swickard, Chairman
Box 569
Susanville, CA 96130

Recreation & Wildlife Committee
Floyd Grigory, Chairman
P. O. Box 173
San Ardo, CA 93450

SPECIAL INTEREST GROUPS (Continued)

American National Cattlemen's Association
c/o John Weber
Regional Vice President
P. O. Box 1518
Alturas, CA 96101

American Society of Range Management
California Section
Bill Harvey, President
3491 Mt. Burnham Pl.
San Diego, CA 92111

Recreational Interests

California Association of 4WD Clubs, Inc.
Ed Dunkley, Conservation Coordinator
P. O. Box 669
Sacramento, CA 95803

Art Lawrence
Lassen Motorcycle Club
P. O. Box 1017
Susanville, CA 96130

Rock & Mineral Interests

California Federation of Mineralogical Societies
William E. Tirk
3944 Aragon Drive
San Diego, CA 92115

Fred Parrish
Reno Gem & Mineral Society
923 Garden
Reno, Nevada 89502

Ivan Hudson
Lassen Rock & Mineral Club
415 Knoch
Susanville, CA 96130

SPECIAL INTEREST GROUPS (Continued)

Sigurd Sonnevil
Modoc Gem & Mineral Club
312 Riverside
Alturas, CA 96101

Phillips Petroleum Company
P. O. Box 752
Del Mar, CA 92014

Nevada Mining Association
1st National Bank Building
Suite 602
1 East First Street
Reno, Nevada 89502

Exploration Geologists of Nevada
c/o Pete Galli
5118 E. Second Street, Suite 20
Reno, Nevada 89502

Gulf Oil Corporation
1780 S. Bellaire
Denver, Colorado 80222

Lahontan Gem & Mineral Club
Fallon, Nevada 89406

Nevada Prospectors Association
P. O. Box 94
Fallon, Nevada 89406

Geothermal

James Miner
c/o "The Geyser"
P. O. Box 1525
Beverly Hills, CA 90213

Wildlife Interests & Sportsmen Interests

National Audubon Society
Paul Howard
Box 4446
555 Audubon Place
Sacramento, CA 95825

SPECIAL INTEREST GROUPS (Continued)

National Audubon Society
Jerry Nordstrom
Raines Road
Janesville, CA 96114

California Wildlife Federation
Harold Hochmuth
6710 Wooster Avenue
Los Angeles, CA 90056

Lassen County Fish, Game &
Recreation Commission
c/o Walt Stone
830 Arnold Street
Susanville, CA 96130

Lassen Fin and Antler Club
625 N. Weatherlow
Susanville, CA 96130

Organized Sportsmen of Lassen County
c/o Jim McQueen
410 S. Roop Street
Susanville, CA 96130

Ducks Unlimited - Nevada
P. O. Box 10100
Reno, Nevada 89510

Ducks Unlimited - Reno
c/o Francis Breen
232 Court Street
Reno, Nevada 89501

Nevada Wildlife Federation
P. O. Box 49
Sparks, Nevada 89431

Wild Horse Organized Assistance, Inc.
P. O. Box 555
Reno, Nevada 89504

California Trout
Dr. George F. Stewart
Department of Food Science
Davis, CA 95616

SPECIAL INTEREST GROUPS (Continued)

Audubon Society
University of Nevada
Flieschman Life Science Building
Reno, Nevada 89500

Audubon Society
Eagle Lake Chapter
President Diane Fuller
Herlong, CA 96113

Modoc Fur, Fish & Feather Club
Alturas, CA 96101

National Wildlife Federation
c/o William Reavley
2717 Cottage Way
4209 Loazell Court
Sacramento, CA 95825

General

Allen Aleck, Chairman
Pyramid Lake Paiute Tribal Council
General Delivery
Nixon, Nevada 89424

UNIVERSITIES AND COLLEGES

Bernard Shanks
Renewable Resources Center
University of Nevada
Reno, Nevada 89502

Lassen College
P. O. Box 3000
Susanville, CA 96130

Water Resources Center Archives
Room 40, North Gate Hall
University of California
Berkeley, CA 94720

UNIVERSITIES AND COLLEGES (Continued)

Norris A. Bleyhl, Director
Regional Information and Records
Project
California State University, Chico
Chico, CA 95929

UTILITY CORPORATIONS, OTHERS

Pacific Gas & Electric Corporation
77 Beale Street
San Frnacisco, CA 94105

Surprise Valley Electrification Corp.
P. O. Box 691
Alturas, CA 96101

Steve Munson
Technology International
400 Montgomery Street
Suite 724
San Francisco, CA 94104

Jack Foehr
CER Corporation
P. O. Box 15090
Las Vegas, Nevada 89114

McCullock Oil Corporation
10880 Wilshire Boulevard
Los Angeles, CA 90024

Earth Power Corporation
522 South Boston Avenue
P. O. Box 1566
Tulsa, Oklahoma 74101

Wayne and Sandra Owen
427 West Avenue G
Lancaster, CA 93534

Gary Stacey
P. O. Box 1480
Redding, CA 96001

UTILITY CORPORATIONS, OTHERS (Continued)

Mike Karbs
BLM-Wyoming State Office
P. O. Box 1828
Cheyenne, Wyoming 82001

Geo Mac, Inc.
2928 H Street
Bakersfield, CA 93301

VTN Consolidated, Inc.
2301 Campus Drive
Irvine, CA 92664

Geothermal Power Corporation
1127 Grant Avenue
Novato, CA 94947

Geonomics, Inc.
3165 Adeline Street
Berkeley, CA 94703

Geothermal Kinetics Systems Corporation
2920 H Street
Bakersfield, CA 93301

Geo Products Corporation
P. O. Box 2903
Oakland, CA 94612

Woodwoard-Clyde Consultants
3489 Kurtz Street
San Diego, CA 92110

Geothermal Resources Council
111 G Street
Davis, CA 95616

NATIVE AMERICANS CONSULTED

Harold Dixon, Chairman
Susanville Indian Rancheria
Susanville, CA 96130

Gladys Mankins
Janesville, CA 96114

X. INTENSITY OF PUBLIC INTEREST

In an effort to gauge public interest concerning proposed geothermal leasing on national resource lands, letters were sent to government agencies, conservation groups, recreation organizations other interest groups and individuals. In addition, one publicly announced meeting and several agency meetings were held to receive public viewpoints concerning the subject EAR (see previous section and appendix references on correspondence). These contacts indicated a strong amount of State and local agency interest and a moderate interest by the general public.

Besides those meetings held in conjunction with development of the current EAR, the geothermal development potential was also discussed in conjunction with the Management Framework Planning (MFP) meeting by the Susanville District Staff. At all meetings efforts were made to bring issues surrounding geothermal leasing before the public and obtain comments.

Prior to publication of the Draft EAR, concern was expressed by the City of Susanville, Lassen County, Lassen County Supervisors, and a few interest groups. The Fish and Wildlife Service, U.S.D.I., Division of Ecological Service, Sacramento, sent a memorandum on general and specific recommendations concerning BLM's geothermal leasing program. However, efforts to achieve active involvement by groups and agencies during draft preparation were fruitless. For the most part, early requests for information or data input by private interest groups were not successful. Most agencies contacted provided information where possible but preferred to review and comment on the draft EAR proor to stating a position on leasing in the project area. The general public has expressed little interest in the issue, but that interest has generally been to proceed with the geothermal program.

The Draft EAR was submitted for public review and comment in June and July, 1977. Comments received and responses to them are as follows. A total of 15 letters were received addressing various aspects of Honey Lake Geothermal leasing. Most of the comments received were neutral as far as indicating support for a specific alternative, the proposed action, no action or proposing that an EIS be undertaken. Only one respondent specifically supported a partial lease alternative. The local Agency Formation Commission of Susanville supported partial lease Alternative 2B. No respondent indicated support for the proposed action, any other partial lease alternative or no action. Two respondents, Clyde Kuhn and Beth Jersey, and the Resources Agency of California felt that BLM should do an EIS.

Not all letters addressing the EAR voiced an opinion or comments. Some simply offered an update on technology (Fred Longyear Co.) and others offered no comment because they felt it was out of their jurisdiction (Nevada State Park System).

United States Department of the Interior

BUREAU OF LAND MANAGEMENT

District Office
P. O. Box 1090
Susanville, California
96130

IN REPLY REFER T
1791 (C-020)
EAR-C-02-7-

JUN 3 1977

Dear Sir:

As part of our review process of the Honey Lake Valley Geothermal Environmental Assessment Record, your review and comments of the enclosed Draft EAR are requested to finalize the document.

A 45 day review period is necessary in order that we completely incorporate all pertinent agency and public comments and maintain the schedule established for finalizing the document. All comments should be received in this office no later than July 20, 1977.

The presentation of alternatives to the proposed action are narrated within the enclosed draft. We would appreciate knowing which alternative you consider to be the best, and why. If none of the alternatives suit your concerns, then please give us your recommendation(s).

If we can provide additional information to you during your review period, please contact Mark T. Morse, Eagle Lake Resource Area Manager, Bureau of Land Management, 705 Hall Street, Susanville, California, 96130, between the hours of 7:45 a.m. to 4:30 p.m., or phone (916) 257-5385.

Sincerely,

C Rex Cleary

C. Rex Cleary
District Manager

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

MIKE O'CALLAGHAN
Governor

NEVADA STATE PARK SYSTEM

JOHN L. MEDER
Administrator

ROOM 221
NYE BUILDING
201 S. FALL STREET
CAPITOL COMPLEX
CARSON CITY,
NEVADA 89710
(702) 885-4384

In Reply Refer to:
561-BLM

Dept. of Interior
RECEIVED
JUN 15 1977
BUREAU OF LAND MANAGEMENT
SUSANVILLE, CALIFORNIA

JUN 14 1977

Mr. C. Rex Cleary, District Manager
Bureau of Land Management
District Office
P.O. Box 1090
Susanville, California 96130

Dear Mr. Cleary:

Subject: HONEY LAKE VALLEY DRAFT ENVIRONMENTAL ASSESSMENT RECORD

We wish to thank you for supplying our office with a copy of the above-mentioned report. It would, however, seem somewhat inappropriate for us to comment since the project is not in, nor does it directly affect, the state of Nevada.

Sincerely,

John L. Meder, Administrator
(State Historic Preservation Officer)

Charles D. Zeier

By: Charles D. Zeier
Archaeologist

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Conservation Division
W-2231 Federal Building
2800 Cottage Way
Sacramento, California 95825

Dept. of Interior
RECEIVED
JUN 28 1977
BUREAU OF LAND MANAGEMENT
SUSANVILLE, CALIFORNIA

June 24, 1977

Memorandum

To: Mr. C. Rex Cleary
District Manager
Bureau of Land Management
Susanville, California

From: District Hydraulic Engineer

Subject: Draft Environmental Assessment Record for Proposed Geothermal Leasing in Honey Lake Valley

Thank you for the opportunity to review the subject draft environmental assessment record. There are no classifications or withdrawals for waterpower or reservoir site purposes, and we are not aware of any plans for major water resource development within the boundaries of the proposed geothermal leasing area.

R D Morgan
R. D. Morgan
District Hydraulic Engineer

CALIFORNIA ASSOCIATION OF 4WD CLUBS INC.
MEMBER

P. O. Box 669, Sacramento, California 95803, 916-444-6504

June 28, 1977

Bureau of Land Management
Susanville District Office
Mr. C. Rex Cleary, District Manager

Dear Sir,

The Draft Statement for the Honey Lake Valley Geothermal Environmental Assessment Record (EAR) has been evaluated as requested.

The proposed action and its resulting impacts are considered to be an acceptable use of natural resource lands. The need for development of alternate sources of clean energy for this nation far outweigh any of the potentially adverse effects that may result from geothermal exploration. We believe the EAR adequately covers all of the known resources in the area and will provide sufficient safeguards and regulations to prevent any significant adverse effects.

One recreational value not covered is the potential development of a public hot springs such as the one located at Gerlach. It is possible that a similar public recreation area could be developed at Honey Lake as a by-product of exploration. Thousands of visitors, mostly from California annually visit the Great Boiling Spring at Gerlach which has only bare essential improvements. Our members would like to see a similar recreation site at Honey Lake.

We thank you for a well prepared report and the opportunity to comment on it.

Sincerely,

Ed Dunkley
Field Representative

ED:js

RESPONSE TO COMMENTS ON DRAFT ENVIRONMENTAL ASSESSMENT RECORD FOR HONEY LAKE VALLEY PROPOSED GEOTHERMAL LEASING

Comments from: Ed Dunkley
Field Representative
California Association of 4WD Clubs, Inc.
P.O. Box 669
Sacramento, Ca 95803

Comment: Page 1, paragraph 3.

Response: Hot springs development at Gerlach is on private property. BLM has nothing to do with this situation. In the Wendel-Amedee and Island study areas there are no hot springs on public land. Thermal fluids from depths 5-10,000 ft. are usually much more laden with polluting chemicals than the water we see at the surface in hot springs. Hot springs water at the surface has been diluted by near-surface ground-water aquifers that are much better in quality and more suitable for public recreation development. Until the quality of thermal fluids on public land is better known, any waste fluid will probably be reinjected outside the geothermal reservoir. At this time development of a public recreation area as a by-product of exploration is probably an unlikely occurrence.

ACT	RT	INT	
			DIST MGR
	✓		ASS'T DIST MGR
	✓		ENV. COORD
	✓		PUBLIC AFFAIRS
			CHIEF, DIV OF RES
			CHIEF, DIV OF OPER
			CHIEF, DIV OF ADMIN
	✓		EAGLE LAKE, A.M.
			PIT RIVER, A.M.
			SUSANVILLE, A.M.

Remarks:

1. Info
2. Lead Action
3. Provide Input
4. Review & Surname
5. Comments
6. See Me
7. File
8. Send Copy

STATE OF NEVADA

GOVERNOR'S OFFICE OF PLANNING COORDINATION

CAPITOL BUILDING, ROOM 45
CAPITOL COMPLEX
CARSON CITY, NEVADA 89710
(702) 885-4865

July 7, 1977

1791 (C-020)
EAR-C-02-7-13

Mr. Rex C. Cleary
District Manager
United States Department of
the Interior
Bureau of Land Management
P. O. Box 1090
Susanville, California 96130

RE: SAI NV #77800057 - Honey Lake Valley Proposed Geothermal Leasing

Dear Mr. Cleary:

Thank you for the opportunity to review the above mentioned project.

The State Clearinghouse has processed the proposal and has no comment. Based on the information contained therein and the responses of interested parties, the proposed project is, as of this date, found not to be in conflict with the State's plans, goals, or objectives.

Sincerely,

for Bruce D. Arkell
State Planning Coordinator

BDA/pf

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
2828 Chiles Road, Davis, CA 95616

July 12, 1977

Mr. C. Rex Cleary
Bureau of Land Management
District Office
P. O. Box 1090
Susanville, California 96130

Dear Mr. Cleary:

We acknowledge receipt of the draft environmental assessment record for Proposed Geothermal Leasing in the Honey Lake Valley Geothermal Activity Area in Lassen County, California, that was addressed to the Soil Conservation Service in June, 1977 for review and comment.

We have reviewed the above draft environmental statement and find that there are no controversial items in the statement within the realm of the Soil Conservation Service's expertise and responsibilities. We find no conflict with any ongoing or planned programs or projects.

In considering the various alternatives, most of the proposed leasing area consists of marginal rangelands. The selected alternative should provide for adequate protection to wildlife, archaeological and recreational resources.

We appreciate the opportunity to review and comment on this proposed project.

Sincerely,

Francis C. H. Lum

FRANCIS C. H. LUM
State Conservationist

cc: R. M. Davis, Administrator, USDA, SCS,
P. O. Box 2890, Washington, D.C. 20013
Fowden G. Maxwell, Coordinator of Environmental Quality Activities,
Office of the Secretary, USDA, P. O. Box 2890, Washington, D.C. 20013
Council on Environmental Quality, 722 Jackson Place, N.W.
Washington, D.C. 2006 - Attn: General Counsel

2207 Carroll Street
Apartment 3
Oakland, California 94606
(415) 451-3714
18 July 1977

C. Rex Cleary
District Manager
Bureau of Land Management
P.O. Box 1090
Susanville, California 96130

Dear Mr. Cleary:

Thank you for your letter of 3 June 1977 and a copy of the Honey Lake Valley Geothermal Draft Environmental Assessment Record (EAR) prepared in compliance with Section 102(2)(A) of the National Environmental Policy Act of 1969 (NEPA) in accordance with Bureau of Land Management (BLM) procedures for environmental assessment as contained in BLM Manuals 1790, 1791 and 1792. We would like to take this opportunity to offer our review comments on the Draft EAR and thereby assist you in finalizing the subject document.

NEPA Section 102(2)(C) Compliance

Volume I of the Final Environmental Statement for the Geothermal Leasing Program (Final ES) prepared in compliance with Section 102(2)(C) of NEPA discussed, in 1973, 638 million acres of public lands potentially available for geothermal leasing in the United States by major biotic communities or biomes. Details on the extent of all potential lease areas and the specific environmental impacts that might pertain to each area, except for three Known Geothermal Resource Areas (KGRAs) in California, were not discussed in the Final ES. According to the Final ES, a site sensitive environmental evaluation would be conducted with respect to land, air, water and biotic resources for each newly proposed geothermal lease project prior to lease-site selection.

The Honey Lake Valley Draft EAR has been prepared in order to analyze environmental impacts which could occur as a result of leasing, for geothermal purposes, 10,334 acres of National Resource Land (NRL) administered by the BLM both within and adjoining the Wendel-Amedee KGRA. The Draft EAR defines two Honey Lake Valley study areas, separated into two major blocks termed the Wendel-Amedee area and the Island area. Within the boundaries of the entire Honey Lake Valley study area there are approximately 20,725 acres of Federal land administered by the BLM and 26,435 acres of land in private holdings. The Federal Government has, moreover, retained subsurface mineral rights on

a total of 1,194 acres within the Honey Lake area. In addition, 19 more tentative geothermal leasing agreements or permit applications for private and state controlled land involving an area of at least 16,000 acres constitutes, together with the Federal land potentially available for geothermal purposes, the greater Honey Lake Valley geothermal project area.

It is recognized in Volume I of the Final ES that the issuance of geothermal leases in proposed leasing areas other than the three California KGRAs for which environmental evaluations were made and published in Volume II of the Final ES might constitute a major Federal action significantly affecting the human environment and thereby require the preparation and dissemination of an environmental statement in compliance with Section 102(2)(C) of NEPA. As of January 28, 1974 Federal agencies have been instructed to comply with Section 102(2)(C) of NEPA in accordance with 40 CFR 1500, Council on Environmental Quality (CEQ) "Guidelines for the Preparation of Environmental Impact Statements (EIS)."

40 CFR 1500.5(a)(2) of the CEQ EIS guidelines identifies the types of major Federal actions significantly affecting the quality of the human environment in the sense of NEPA Section 102(2)(C) and for which environmental impact statements must be prepared as including new and continuing projects and program activities involving a Federal lease, permit, licence, certificate or other entitlement for use. In 40 CFR 1500.6(a) of the CEQ EIS guidelines Federal agencies are instructed on identifying major actions significantly affecting the environment. In considering what constitutes major Federal action significantly affecting the environment, agencies must bear in mind that the effect of many successive Federal decisions about a project or complex of projects can be individually limited but cumulatively considerable. An EIS should be prepared, therefore, if it is reasonable to anticipate a cumulatively or collectively significant impact on the environment from Federal action.

Inasmuch as (a) the Honey Lake Valley geothermal project area was not one of the three California KGRAs for which an environmental evaluation was published in Volume II of the 1973 Final ES; (b) the proposed undertaking is part of a continuing program activity involving a Federal lease, permit and other entitlement for use; and, (c) it is reasonable to anticipate cumulatively and collectively significant impacts on the environment from successive Federal approval of "Notices of Intent to Conduct Geothermal Resources Exploration Operations," issuance of competitive and non-competitive geothermal leases as well as subsequent geothermal development operations; we conclude that the preparation of an EIS in compliance with NEPA Section 102(2)(C) and in accordance with 40 CFR 1500 CEQ EIS guidelines is mandatory prior to any agency decision regarding

geothermal leasing in Honey Lake Valley.

NHPA Section 106 and EO 11593 Compliance

A cursory description of the geological human interest and archaeological values of each of the five different major biotic communities or biomes constituting the 638 million acres of public lands potentially available for geothermal leasing in the United States is included in Volume I of the Final ES. Consideration of the geological human interest and archaeological values for the Wendel-Amedee KGRA is not included in the Final ES.

The Honey Lake Valley geothermal Draft EAR describes the archaeological and historical resources of the proposed lease area. These elements of the existing environment were identified through an intensive, on-the-ground archaeological survey of 10,334 acres of proposed lease land and 2,040 acres of NRL adjoining the proposed lease area. As a result of this investigation, archaeological districts and an archaeological site in the Wendel-Amedee study area and the co-occurrence of several archaeological cultural resources which may constitute two different archaeological districts and one historic site in the Island study area all appear either to quality for inclusion or, according to the Draft EAR, will be submitted for formal determination of eligibity for inclusion on the National Register of Historic Places (National Register) established by the National Historic Preservation Act of 1966 (NHPA).

Section 106 of NHPA requires that the President's Advisory Council on Historic Preservation (Advisory Council) have an opportunity to comment on any undertaking which adversely affects properties listed, nominated, or considered important enough to be included on the National Register. Executive Order 11593, May 31, 1971, "Protection and Enhancement of the Cultural Environment (EO 11593)," supplements the NHPA by ordering all Executive Branch agencies of the Federal Government to compile an inventory of archaeological, architectual and historical structures, sites and districts and related cultural resources for which they are trustee, nominate all eligible government properties to the National Register, preserve and protect their cultural resources, and insure that agency activities contribute to the preservation and protection of non-Federally owned cultural properties.

As of January 25, 1974 Federal agencies have been instructed by 36 CFR 800, Advisory Council "Procedures for the Protection of Historic and Cultural Properties," to coordinate NEPA Section 102(2)(C) compliance with agency obligations under NHPA and EO 11593 to ensure that historic and cultural resources are given proper consideration in the preparation of environmental

statements. In addition, 40 CFR 1500 CEQ EIS guidelines direct that compliance with Section 102(2)(C) of NEPA should be combined as fully as possible with other statutory obligations such as those mandated with NHPA and EO 11593 to yield a single statement which meets all applicable requirements. Federal agencies are instructed, therefore, by both the Advisory Council and CEQ to undertake compliance with NEPA, NHPA, and EO 11593 in accordance with 40 CFR 1500 EIS guidelines and 36 CFR 800 procedures whenever properties included in or eligible for inclusion in the National Register are involved in a project.

All 36 CFR 800 Advisory Council procedures have not yet been met in anticipation of the proposed undertaking. According to the Draft EAR, to identify the potential environmental impact of the undertaking upon cultural properties included in the National Register, the BLM correctly consulted the National Register in accordance with 36 CFR 800 procedures. To identify properties potentially eligible for inclusion on the National Register, however, only a portion of the entire area of potential primary, secondary, direct and indirect impact (10,334 acres of proposed lease land and 2,040 acres of NRL adjoining the proposed lease area) was examined in accordance with 36 CFR 800 procedures. While it was stated at the time of Draft EAR preparation that certain archaeological and historical features within the project area were of National Register quality, the appropriate criteria had not been applied in consultation with the appropriate State Historic Preservation Officer (SHPO) in order to obtain a formal determination of such eligibility.

The National Register significance of all cultural resources, not only those located within the 12,374 acres of inventoried land, but of the entire 20,725 Federally controlled and mineral-rights-reserved acreage inclusive of the Honey Lake Valley geothermal project area must be ascertained by the BLM in consultation with the SHPO in accordance with Advisory Council 36 CFR 800 procedures. A determination of the undertaking's primary, secondary, direct and indirect impacts upon each National Register quality property must be made, and for each property affected, criteria of adverse effect must be applied. Adverse effects, as defined by 36 CFR 800.9 of the Advisory Council procedures, occur under conditions which include the introduction of visual, audible or atmospheric elements that are out of character with the property or alter its setting. Upon finding the effects of the proposed undertaking to be potentially adverse, the BLM must then advise the Advisory Council and the SHPO, prepare a preliminary case report containing all relevant information concerning the undertaling, and proceed with the consultation process set forth in 36 CFR 800.5 of the Advisory Council procedures in a review of the proposed undertaking and its impact by appropriate

agencies and the general public.

Following a complete evaluation of the undertaking; its primary, secondary, direct and indirect effects; and possible alternative actions in the manner outlined in the Advisory Council 36 CFR 800 procedures; the findings, conclusions and recommendations of the Advisory Council must then be adopted and incorporated in the published evaluation of impacts in a Draft EIS prepared in compliance with Section 102(2)(C) of NEPA and in accordance with 40 CFR 1500 CEQ EIS guidelines in order to offer general and professional reviewers the opportunity to consider all potential impacts, the significance of threatened resources, and all methods available to avoid or minimize adverse impacts.

Considering the inter-jurisdictional character of probable governmental actions relating to future geothermal undertakings and considering the fact that the cultural resources located on adjoining State of California and privately held land within the 47,160 acre Honey Lake Valley geothermal project area may be adversely impacted by project authorization on Federally controlled land, the assessment of cultural resource values should definitely be made in a single document in cooperation with State and local authorities in accordance with NEPA, the EO 11593 mandate to Federal agencies ordering them to insure that agency activities contribute to the preservation and protection of non-Federally owned cultural resources, and the California Environmental Quality Act of 1970 (CEQA).

<u>Cultural Resources Inventory and Impact</u>

An inventory of archaeological resources within the 10,334 acres of proposed lease area and 2,040 adjoining NRL acres, an inventory of historic resources with the Island study area, and a list of several historic sites and monuments on NRL within the Wendel-Amedee areas is included in the Draft EAR. On the basis of this information the anticipated individual and cumulative impacts of each stage of geothermal development upon eight generalized categories of prehistoric archaeological sites and the projected impacts of geothermal development upon individual historic features is discussed and projected for each potential leasing unit in the Draft EAR. Impact ratings for "archaeology and cultural resources" broken into two groups according to "the degree of impacts throughout the discrete operational analysis" are also included in the Draft EAR.

It is obvious, first of all, that not only has the 20,725 acre Federal area of the undertaking's potential primary, secondary, direct and indirect impact not been totally evaluated in accordance with Advisory Council 36 CFR 800 procedures, but the method of impact evaluation presented in the Draft EAR does not meet Advisory Council procedural criteria for the determination of effect and finding of adverse effect. Prehistoric and historic

archaeological sites and features, moreover, are only two individual elements of a far greater cultural resource base which has to be identified and evaluated prior to the lease action.

Cultural resources are basic elements of the human environment. Patterns of contemporary human activity, non-physical and written traditions of contemporary and past human activity, and physical manifestations of past human activity are of social, economic, historic and scientific value. Altogether these elements constitute what has been termed the "cultural environment." Past human activity took place in some form of past cultural and environmental physical context. To understand this past activity, artifacts and other cultural remains of human manufacture in archaeological settings must be studied, historic and other written documents which may in any way pertain to or shed light upon this activity must be reviewed, and non-cultural physical and environmental associations essential to understanding the context and duration of past human activity must be carefully evaluated.

How much of the cultural resource base, as defined above, within the 47,160 Federal and non-Federal acres of the undertaking's potential primary, secondary, direct and indirect environmental impact will be immediately threatened by the proposed undertaking, or will be ultimately threatened by incremental geothermal undertakings has been only partially determined, inasmuch as the cultural resource evaluation contained in the Draft EAR is limited to only historic and archaeological elements for no more than 12,374 acres - only 26% of the potentially affected area. Too small of an area was assessed to reliably determine the context and duration of past human activity or to confidently interpret the kinds of prehistoric activity manifested at each archaeological site except at the most gross non-temporal level. In short, insufficient baseline data has been gathered to anticipate the effects of the proposed undertaking, to monitor the cumulative impacts of subsequent geothermal undertakings or to anticipate the effect of potential impacts at the field development phase upon the cultural resource base.

Additional on ground investigations are necessary in the Honey Lake Valley, therefore, to identify all paleontological, prehistoric and historic archaeological and unique geological sites, non-cultural physical and environmental associations essential to understanding the context and duration of past human activity and areas of cultural significance to the contemporary Native-American community in an area sufficient enough in size and in a manner intensive enough in detail to ascertain the context and duration of past human activity and to tentatively evaluate the significance of each and every

cultural and related feature within all Federally controlled and mineral-rights-reserved land included in the 47,160 acres of the greater Honey Lake Valley geothermal project area.

Cultural Resource Mitigation

Volume I of the geothermal Final ES states that mitigation of potential environmental problems and impacts stemming from geothermal exploration and development activity can be accomplished through enforcement of applicable Federal, state and local laws and regulations, geothermal exploration and leasing regulations, geothermal operating regulations, Geothermal Resource Operational (GRO) Orders, lease and land-use permit stipulations, and application of existing and developing and yet to be developed technologies (pg III-4).

a. Geothermal Leasing Regulations

Geothermal leasing regulations which apply to cultural resources are contained in Chapter II, Title 43 CFR 3204.1(h), BLM "General Regulations for Geothermal Resources Leasing," which stipulates that lessees will conduct activities on discovered, known and suspected archaeological, paleontological or historic sites in accordance with lease terms or specific instructions. This regulation is inconsistent with and procedurally conflicts with Advisory Council 36 CFR 800 procedures and CEQ 40 CFR 1500 guidelines which stipulates that in accordance with NHPA, EO 11593 and NEPA cultural resources will be identified, evaluated and, if necessary, mitigation measures adopted prior to the time entitlement to use is awarded in the form of a lease.

b. Lease and Land Use Stipulations

In accordance with the BLM's authority to develop special leasing stipulations and conditions when necessary to protect the environment and all other resources, a set of seven cultural resource mitigation procedures are proposed in the Draft EAR (pgs IV-17 - IV-19). These proposed cultural resource mitigation procedures can be critized as follows:

(1) It has been recently documented that archaeological sites have been damaged or destroyed by geothermal resource development at The Geysers after they had been identified in the environmental review process and after appropriate mitigation measures, such as avoidance or non-occupancy had been developed. The fact that there is no cultural resource compliance and followup program at The Geysers and the fact that known sites have been destroyed in spite of appropriate avoidance recommendations is an indictment of the effectiveness of the non-occupancy stipulation contained in the Draft EAR. (2) Inasmuch as the cultural resource leasing impact matrix contained in the Draft EAR is predicated upon an incomplete evaluation of the total resource

base, the validity of any single prediction as to the degree of impact in any particular area or zone, a factor essential to the success of this particular non-occupancy stipulation, would be questionable, if not outright unfounded in empirical reality.

(3)&(4) The manner in which it is proposed that the special antiquities stipulation contained in the Draft EAR will be implemented in place of Section 18 of the Standardized Lease Terms does not differ from the way Section 18 has been applied in the past. Anything but an encouraging prospectus for the future is suggested in a review of past fulfillment of the Section 18 lease terms. In the case of a 1976 exploratory geothermal project in Long Valley (Mono County, California), for example, "qualified archaeologists" engaged and paid for by the lessee to conduct a post-lease archaeological survey in a manner acceptable to the BLM, and in a manner consistent with the suggested procedure outlined in the Draft EAR, produced an impoverished written report that plagiarized information, in places taken verbatim, from A.L. Kroeber's 1923 Handbook of the Indians of California. Not only were these so-called "qualified archaeologists" far afield of their geographic area of expertise, they failed to inform themselves of research conducted in the area subsequent to the 1923 publication of Kroeber's Handbook and thereby not only misinterpreted inventoried cultural resources, but seriously under-estimated the cultural resource base and failed to recommend procedures sufficient enough to ensure the avoidance of both direct and indirect impacts which could be reasonably expected from the undertaking.

Expressively exempted from the special antiquities stipulation, moreover, is the drilling of shallow holes for the measurement of temperature gradient and heat flow up to a depth of 500 feet provided that such drilling is immediately adjacent to existing roads and trails and that the drilling sites have been previously inspected by the BLM. However, inasmuch as (a) the total cultural resource diversity of the project area has not been ascertained; (b) cultural debris and other related non-cultural features essential to understanding the context of past human activity may be incorporated in unimproved roadbeds and adversely impacted by any form of vehicular traffic; and (c) any decision on the cultural resource significance of any particular drill site would be made on an unilateral and case-by-case basis by the BLM; cultural resource options are certain to be consistently foreclosed and adverse impacts inflicted upon cultural resource values in the course of such "exempted" operations.

(5)&(6) In part on the basis of cooperative agreements and a memorandum of understanding between the Federal agencies sharing a management or regulatory responsibility for the geothermal program, procedures have already been established for the coordination of post-lease environmental analysis.

For each geothermal undertaking which requires the filing of a Plan of Operation, such as a "Notice of Intent" to conduct geothermal exploration, prospecting operations and drilling, an Environmental Analysis (EA) is prepared by the U.S. Geological Survey (USGS) prior to project approval. A standardized format for EA preparation is used by the USGS. Any archaeological reports requested of the lessee in compliance with Section 18 of the standardized lease terms, or will be required in compliance with the special antiquities stipulation proposed in the Draft EAR, are incorporated in the post-lease EA.

As part of the EA preparation process the proposed action is reviewed on site and any environmental problems noted and discussed in the field. As the Federal agency with what the USGS terms cultural resource "expertise," EA input on archaeological aspects of the action is, and in accordance with the Draft EAR proposed mitigation prospectus, will continue to be provided exclusively by the surface management agency (BLM). All of the information gathered from the site inspection and from other agencies, such as the BLM with respect to cultural resources, is evaluated in the EA and recommendations made, at the end of the EA, whether or not the proposed action appears to constitute a "major Federal action" as defined by Section 102(2)(C) of NEPA.

Without exception, past USGS geothermal EAs have concluded that successive geothermal undertakings in California (such as geophysical exploration and geothermal exploratory drilling) do not individually constitute a major Federal action in the sense of NEPA Section 102(2) and consequently, there has never been a geothermal EIS prepared by the USGS in compliance with NEPA Section 102(2)(C) and in accordance with 40 CFR 1500 CEQ EIS guidelines for a geothermal project on a locality or site-specific basis in California. Inasmuch as Federal agencies are instructed by the CEQ to comply with NHPA and EO 11593 in the manner outlined in 36 CFR 800 Advisory Council procedures only when it is determined that the proposed undertaking is a major Federal action, and the USGS consistently concludes that the geothermal undertaking under consideration at the time is not a major Federal action, NHPA, EO 11593 and the Advisory Council 36 CFR 800 procedures are, and any review, transmittal or implementation of the archaeological report and cultural resource program of mitigation contained therein as the Draft EAR proposes to require, would be automatically by-passed at each phase of the geothermal development chronology, including preliminary exploration, exploration drilling and, as has been the case to date, most phases of subsequent field development.

This means that there is and will continue to be no SHPO and Advisory Council review of the manner in which cultural resource investigations were carried out for the EA as prescribed by the

existing Section 18 of the standardized lease terms or the special antiquities stipulation proposed in the Draft EAR in replacement of Section 18, no evaluation of the adequacy of mitigation measures or plans, no consultation as to the National Register eligibility of discovered cultural resources, no determination of effect, no finding of adverse affect, and no consultation process as may be required for the proper evaluation of the undertaking, its effects, and alternative courses of action as outlined by the Advisory Council throughout the entire post-lease geothermal development chronology.

Further considering that (a) the prelease evaluation of cultural resources as presented in the Honey Lake Valley geothermal Draft EAR is not in compliance with Advisory Council procedures for identifying cultural resources or determing their National Register quality or applying the appropriate criteria of adverse effect to each cultural property of confirmed National Register quality in consultation with the SHPO; (b) the projection of environmental impacts expected upon cultural resources contained in the Draft EAR is inconsistent with the manner Advisory Council criteria of effect are to be applied; (c) the proposed mitigation scheme as outlined in the Draft EAR does not ensure that Advisory Council 36 CFR 800 procedures for the protection of historic and cultural properties will be met in the post-lease phases of the geothermal development chronology; and, (d) without exception past BLM geothermal Final EARs have concluded at the NEPA Section 102(2)(A) level that the decision to proceed with leasing at specific KGRAs and non-competitively defined geothermal project areas in California does not "strickly speaking" consist of project authorization, require the BLM to forfeit options toward the protection of cultural resources or the mitigation of impacts upon them; or in short, does not constitute a major Federal action in the sense of NEPA Section 102(2)(C) and thereby necessitate the preparation of an EIS in accordance with CEQ 40 CFR 1500 guidelines or compliance with NHPA and EO 11593 in accordance with Advisory Council 36 CFR 800 procedures; it can be concluded that unless Advisory Council procedures are fully complied with prior to leasing, NHPA, EO 11593 and 36 CFR 800 procedures will be automatically bypassed throughout the life of the entire Honey Lake Valley geothermal program chronology.

(7) Inasmuch as, according to the Draft EAR's cultural resource mitigation prospectus, the total Honey Lake Valley geothermal project area's cultural resource base and diversity will not be determined and evaluated prior to leasing and Advisory Council procedures for the determination of cultural resource significance will be delayed until after an entitlement for use has been awared in the form of a geothermal lease, subsequent application of Advisory Council procedures in the manner dictated in 36 CFR 800 could theoretically result in the identification of a portion of a leasehold, an entire leasehold,

or the area immediately adjacent to a leasehold as potentially eligible for inclusion on the National Register or otherwise significant for its historic, cultural or scientific value. Ordering the non-occupancy of the leasehold, curtailing exploration and development activities on adjacent lands, imposing restrictions in order to prevent adverse impacts such as the introduction of visual, audible or atmospheric elements that are out of character with the cultural resource property or alter its setting, or ordering any similar measures as suggested in the Draft EAR's cultural resource mitigation prospectus to preserve cultural resources and related values in a manner consistent with NHPA, EO 11593, or the Historic Sites Act of 1935 (Public Law 74-942) would clearly conflict with the entitlement to use rights implied in the lease. It is probable that the Federal Government would be liable for any damages claimed by the lessee in denying them use of the leasehold in the manner entitled them.

c. Geothermal Resource Operational Orders

USGS Geothermal Resource Operational (GRO) Orders also contain mitigation procedures for cultural resources.

GRO Order No. 1 stipulates that a cultural resources investigation approved by the USGS shall be performed prior to any surface disturbance on a leasehold other than Casual Use. Casual Use includes any entrance on the leased lands for "non-disturbing" geophysical surveys and reconnaissance operations subsequent to leasing. Casual use operations do not require the filing of a "Notice of Intent" to conduct geothermal exploration and a geothermal EA is not prepared for Casual Use projects by the USGS.

GRO Order No. 1 implements Section 18 of the standard lease terms and that element of the geothermal management program has been critized in detail above. Causal Use operations, moreover, are often conducted over a landscape littered with cultural debris such as prehistoric artifacts and non-cultural physical and environmental debris (ecofacts) essential to understanding the context and duration of past human activity and it is reasonably possible, if not actually common, for personnel engaged in "non-disturbing" geophysical surveys and reconnaissance operations to collect projectile points, stone artifacts, fossil remains or other artifactual and ecofactual debris as curios. In areas characterized by surface scatters of tools and chipped stone artifactual debris (alsotermed fragile pattern sites), such as in the Honey Lake Valley, surface collecting, especially if it involves the removal or displacement of diagnostic stone tools can have a major and irreparable adverse impact upon the cultural resource base. In short, cultural resource mitigation measures are actually needed at the Casual Use phase

in order to protect and preserve fragile pattern sites, lithic scatters and other associated surface phenomenon. In practice, this would mean that at least one archaeologist is needed to accompany every geophysical team in the field at the Casual Use phase of geothermal exploration.

GRO Order No. 4 stipulates that the lessee will exercise diligence in protecting and preserving significant archaeological, historical, cultural, paleontological, and unique geological sites and shall not disturb any known cemetary or burial ground of any group or culture. Upon the discovery of any previously unknown cultural resource, the lessee will cease operations until such time as the site can be assessed for its archaeological value and preservation. Necessary contols and remedial actions for the protection and preservation of cultural resources shall be issued on an individual site basis by the USGS as warrented. The preservation, restoration, maintanence and nomination of all resources for purposes of the National Register shall be in accordance with EO 11593 or any amendments thereof.

Under the Antiquities Act of 1906 (Public Law 74-942), the protection and preservation of all objects of antiquity is mandatory upon all land owned or controlled by the Federal Government. The initial part of GRO Order No. 4 simply rearticulates existing law.

The Archaeological Conservation Act of 1974 (Public Law 93-291) provides, moreover, for the recovery, protection and preservation of historical and archaeological data (including relics and specimens) which might otherwise be irreparably lost or destroyed as the result of any alteration of the terrian caused as a result of any Federally licenced project. Whenever any agency finds or is informed that its activities in connection with any Federally licenced project may cause irreparable loss or destruction of significant scientific, prehistoric, historical, or archaeological data, the agency shall notify the Secretary of Interior in writing and provide appropriate information concerning the project. The agency may also request the Secretary to undertake the recovery, protection and preservation of endangered cultural resource data.

Likewise, upon notification by any Federal or State agency or appropriate historical or archaeological authority that any scientific, prehistoric, historic or archaeological data is being or may be irrevocably lost or destroyed by any Federally licenced program, if the Secretary of Interior determines that such data is significant and is being or may be irrevocably lost and after reasonable notification to the agency responsible for licensing the project, the Secretary shall conduct or cause to be conducted a survey and other investigation of

the areas which are or may be affected and recover and preserve such data in his opinion which should be recovered and preserved in the public interest. The Secretary of Interior shall also compensate any entity damaged as a result of delays in construction because of such recovery and conservation practices.

Obviously necessary controls and remedial action for the protection and preservation of cultural resources discovered in the course of geothermal operations are not, according to the Archaeological Conservation Act of 1974, to be issued on an individual site basis solely as warrented by the USGS.

d. Enforcement of Applicable Federal and State Laws

Lastly, as of January 25, 1974 Federal agencies have been instructed by the Advisory Council to comply with EO 11593 in the manner outlined in the Advisory Council 36 CFR 800 procedures. In the parlance of GRO No. 4, EO 11593 has been thereby "amended." As we have noted in detail above, these Advisory Council procedures stipulate that the cultural resource base within the area of the undertaking's potential environmentl impact must be identified, evaluated and steps taken to preserve, enhance, restore or protect such features prior to the time and not subsequent to entitlement to use is made in the form of a geothermal lease. Besides, according to the Final ES, all geothermal guidelines, regulations and orders which might be devised to implement the geothermal management program are superseded by all applicable Federal and State laws and application of NHPA, NEPA and CEQA as implemented by Advisory Council 36 CFR 800 procedures, CEQ 40 CFR 1500 EIS guidelines and State EIR guidelines would result in the fulfillment of all appropriate inventory, evaluation and preservation steps prior to the time entitlement to use is made.

Cultural Resource Documentation

According to the Draft EAR, archaeological site survey forms for all archaeological sites recorded or rerecorded during the 1976 survey of the Wendel-Amedee study area will be filed with the Society for California Archaeology (SCA) regional clearinghouse at Chico and with the California Archaeological Survey maintained by the Department of Parks and Recreation. In addition, qualified researchers may obtain site data from the Susanville District Office of the BLM (pg II-101). In order to identify archaeological resources in the Island study area a professional services contract was let to the Archaeological Research Facility of the University of California, Berkeley. The information generated from this study is apparently summarized in a report on file with the Susanville District Office (pgs II-107 and XII-2).

The SCA has adopted a resolution calling for the filing of copies of archaeological evaluative reports prepared in anticipation of proposed undertakings describing the area reviewed, the methods of identification and analysis used, the resources discovered, the significance of these resources in terms of their scientific importance and their possible value to the community, the predicted impacts of the proposed action on the resources, and recommendations for mitigation of all such impacts with its district clearinghouses. If such data is summarized in an actual environmental document, in all cases reference should be made to a complete report and site records filed in a location to which qualified scholars and appropriate reviewers have access. Failure to make such data available to one's professional colleagues is regarded by the Society as substantial evidence of unethical behavior.

The fact that archaeological survey and site data generated for the Wendel-Amedee area in conjunction with the preparation of the Honey Lake Valley geothermal Draft EAR has not been summarized in a complete report and is available only upon request to qualified researchers obviously does not meet the professional and procedural standards adopted by the SCA. In addition, in the absence of information indicating otherwise in the Draft EAR, we assume that site data generated in the inventory of the Island area has not been submitted to the SCA regional clearinghouse or the California State Archaeological Survey regional office for incorporation in the permanent archaeological inventory and that the report has not been submitted to the clearinghouse archives where it would be available for professional review and future reference.

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Due to the limited amount of time available for review of the subject document, it has not been possible to develop a full critique of other major Draft EAR inadequacies, such as the failure to collect and document sufficient baseline data on seismicity, slope stability, micro-environmental and microclimatic conditions, air quality, rare and endangered plant species, invertebrate fauna and lower flora, the ecology of Honey Lake, the living components of the ecosystem and the tropic interrelationships between species upon which incremental impacts of geothermal development in the Honey Lake Valley could be successfully monitored or detected and adverse impacts eventually mitigated against; the failure to report on Federal and State activities and decisions which have been taken or proposed influencing the character and rate of geothermal development in the Honey Lake Valley; and failure to report the past history of unsuccessful geothermal exploration activity in the Honey Lake Valley.

Thank you, nevertheless, for the opportunity you have given us to review the subject document and to offer comments on the Federal Geothermal leasing and management program. Be advised that copies of this letter will be widely distributed to other such representatives of National and state units of government sharing administrative, statutory, and review responsibilities in the Nation's historic preservation program; to other selected Federal and State agencies; to public interest organizations; and to individual members of the scientific community and concerned public.

Sincerely,

Clyde Elley Kuhn Beth Jersey

Clyde E. Kuhn & Beth A. Jersey

RESPONSE TO COMMENTS ON DRAFT ENVIRONMENTAL ASSESSMENT RECORD
FOR THE HONEY LAKE VALLEY PROPOSED GEOTHERMAL LEASING

Comments from: Clyde E. Kuhn, Beth A. Jersey
2207 Carroll Street, Apartment 3
Oakland, California 94606

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Comment: Page 1, 2; NEPA Section 102(2)(c) Compliance, "we conclude that the preparation of an EIS in compliance with NEPA Section 102(2)(c) and in accordance with 40 CFR 1500 CEQ EIS guidelines is mandatory prior to any agency decision regarding geothermal leasing in Honey Lake Valley."

Response: The need for an environmental statement is based only on: (1) the existence of controversy with respect to the proposed action or project: or (2) the potential for significant impacts on the human environment (see NEPA, P.L. 91-190; CEQ, Guidelines, 1973, S1500.6(a) resulting from implementation of the proposed action. The determination of controversy and significant impacts will be made by the responsible official and will be set forth in a memorandum separate from the EAR (BLM Manual 1791.26).

Comment: Page 3, 4, 5; NHPA Section 106 and EO11593 Compliance, 36 CFR 800 The reviewers suggest that since only 12,374 acres of land (including all potential leasing tracts) were inventoried for cultural resources in accordance with 36 CFR 800 procedures, the study is deficient in its identification of impacts on cultural resources of National Register quality. It is suggested that additional inventory, evaluation, and determination of adverse affects must be performed to cover the entire 20,725 acres of Federally controlled and mineral-rights-reserved land.

Response: While the Honey Lake Valley geothermal study area includes an acreage larger than that which was actually examined and evaluated for cultural resources, intensive survey focused on the potential lease tracts as constituting those areas in which direct impacts might be realized by geothermal development. We concur with the reviewers' implied contention that indirect or 'secondary' impacts might accrue to cultural resources outside of the potential leasing tracts as a result of full (and unregulated) development, and suggest further that this concern cannot realistically be limited even to the 8,351 acres of unsurveyed Federally controlled lands within the

geothermal study area. The specific siting of geothermal power plants, the volume and direction of runoff, and the point of departure and subsequent trajectory of pipelines and powerlines all might indirectly impact cultural resources well beyond the immediate theater of development. The identification of such off-site impacts, however, let alone quantification of them, is contingent upon analysis of the specific developments proposed within any given leasing tract. Only when site-specific details of development are defined can the nature and extent of impacts be analysed. Thus the recognition of specific impacts must await the filing of a plan of operations, subject to approval or revision, and thus the enactment of appropriate mitigative strategies is deferred till this stage. It is underscored that SHPO and Advisory Council consultation, as per 36 CFR 800, is built into the review of the mitigation proposed at the plan of operations stage (as specified in the Draft EAR).

Comment: Page 5, Cultural Resources Inventory and Impact, paragraph 1 and 2.

Response: The possibility of disturbance to an immediate site and the surrounding character that qualifies the property under National Register criteria has been taken into consideration. Under characteristics and considerations of each alternative presented in Chapter VIII, no surface occupancy will be allowed where known sites of National Register Quality occur. Buffer zones around each immediate site have been defined by the District Archaeologist and incorporated into the total area to be included within the no surface occupancy designation.

Comment: Page 6, paragraphs 1, 2, and 3.

Response: We concur that the physical, spatial, and ecological context of prehistory and history holds information important to the interpretation of past systems of human behavior, and that these crucial categories of data must be integrated into any study which purports to unravel the details of culture history and posit generalizations on culture process. We feel, however, that the more modest scope of the present inquiry has realistically confronted the problems of identifying the physical traces of past human activity and tentatively evaluating their significance. That "the context and duration of past human activity" have not been determined "except at the most gross non-temporal level" owes not to a failure of methodology so much as it does to the nature, intent, and requirements of an evaluative survey designed not to write prehistory, but to signal the occurrence of impacts on resources and to define mitigative measures.

The scope of inquiry prescribed by the reviewers pertains not so much, we feel, to the evaluative stage of investigation as it does to that moment when all future cultural resource options are truly foreclosed in the phrasing of an excavation (or 'salvage') research design. Both 'context' and 'duration' require carefully parsed strategies for their discovery, and both are elements which will be required whenever cultural resources are actually threatened. We suggest, as a minimum, that paleoecological data (in the form of sediment analysis, palynology, phytolithology, and faunal sequences), and firm relative and absolute chronological controls (in the form of artifact typology, obsidian sourcing and hydration analyses, and radiocarbon determinations of organic fractions) must be elements of any effective impact mitigation, but they are not necessary at the environmental assessment stage of surface reconnaissance and evaluation.

Moreover, we direct the reviewers' attention to the large body of other environmental (non-cultural) data which has been assembled in the EAR. Particularly, the descriptions of the geology, soils, watershed, vegetation, and wildlife of the project area constitute a significant baseline which all future researches into the cultural ecology and prehistoric systematics of Honey Lake Valley must take as a point of departure. We suggest that the integration of such data into carefully phrased research designs will result, should cultural resources actually be threatened, in the recovery of information equal to the interpretive challenge posed by the reviewers.

Comment: Page 7, a. Geothermal Leasing Regulations.

Response: Reference to 43 CFR 3204.1(h) indicates that the wording may be somewhat misleading. BLM fully intends to protect discovered, known or suspected archaeological, paleontological or historic sites in accordance with all applicable laws and where appropriate, special stipulations will be attached to Notices of Intent to Conduct Geothermal Resource Exploration Operations and Geothermal Leases.

Comment: Page 7, b. Lease and Land Use Stipulations, 1.

Response: It is felt that the purpose of the archaeological impact matrix has been served (to identify site specific impacts within the context of potential lease units). There will be a cultural resource compliance and followup program in Honey Lake Valley that will be a part of Section 18 compliance.

Comment: Page 7, b. Lease and Land Use Stipulations, 2.

Response: It is felt that non-occupancy will handle protection of the most valuable archaeological and historic resource, and Section 18 compliance in the geothermal lease will handle site-specific plans of operation before disturbance occurs.

Comment: Page 8, 3 and 4, first paragraph.

Response: Susanville District will stand behind the qualifications and ability of its Authorized Officer and District Archaeologist to ensure that the engaged archaeologist is adequately qualified to fulfill the requirements of an archaeological survey.

Historical shortcomings of Section 18 compliance, while not indicting the principal of post-lease cultural resource survey, signal potential pitfalls in quality control which merit added safeguards. To this end, it is emphasized (a) that the 'qualified archaeologists' conducting post-lease survey must operate under a valid antiquities permit, (b) that their report and recommendations are to be reviewed for adequacy by BLM professional cultural resources staff, and (c) that proposed mitigation measures (ranging from avoidance to salvage) be subject to SHPO and Advisory Council review prior to execution.

Comment: Page 8, second paragraph.

Response: The reviewers correctly note, but appear to dismiss, that all such drill sites msut be inspected and approved by BLM. This means that cultural resource ground survey will be conducted prior to any drilling operation, and that avoidance of cultural resources will be the indicated option (a standard procedure which has been enacted in the past in the Susanville District). Owing to the flexible requirements of shallow temperature gradient testing, significance of cultural resources is not an issue; <u>all</u> sites can be avoided through relocation of drilling stations.

To the reviewers' contention that culturally significant material may be incorporated in unimproved road beds and could be impacted by any form of vehicular traffic we can only acquiesce, but cannot formulate a realistic active response. Over 98 percent of the road mileage in Lassen County consist of unimproved dirt roads used daily by farmers, ranchers, recreationists, law enforcement officials, a host of Federal

agencies, and an occasional archaeologist. Providing, as they do, the only public access to over a million acres of public land, these roads are not likely to be closed by BLM fiat while cultural resource evaluations of each is performed. We point out, however, that all roads within the potential leasing tracts have already come under cultural resource scrutiny, and that by separate management decision (not related to the geothermal program) general access may be restricted where cultural resource impacts are identified.

Comment: Page 8-10, 5 and 6, Reviewers maintain that the history of Environmental Analyses prepared by USGS in anticipation of geothermal exploration, prospecting and drilling has lead in the past, and automatically will lead, to circumvention of NHPA, EO 11593, 36 CFR 800, and implementation of the Draft EAR's cultural resource mitigation program.

Response: Again, the reviewers dismiss the role which BLM, as surface management agency, will play in ensuring compliance with cultural resource protective mandates and procedures. As the reviewers note, the EA preparation requires cultural resource input from BLM on the occurrence, significance, impacts, and required mitigation of impacts on cultural resource values which might be adversely impacted by the proposed action. We feel that only when the Plan of Operations is proposed, the required archaeological survey and evaluation conducted, and the resulting report reviewed as per 36 CFR 800 procedures, can such input be rendered responsibly. Therefore, BLM's input to any USGS EA must be, and in Honey Lake Valley will be, accompanied by full compliance with Advisory Council procedures, including SHPO and Advisory Council review of cultural resource identifications, National Register evaluations, determinations of effect, and assessment of the adequacy of proposed mitigation measures. We propose that until site-specific Plans of Operations are filed, the determination of impacts on cultural resources and the articulation of strategies of mitigation for them are premature, and that the most reasonable option in the interim is the imposition of non-occupancy stipulations for areas of identified sensitivity (as contained in all partial leasing alternatives of the Draft EAR).

Comment: Page 10-11, (7), The reviewers contend that post-lease application of 36 CFR 800 procedures could conflict with the entitlement of use implied in the granting of a lease, and could result in Federal Government liability for damages claimed by the lessee should the required cultural resource survey result in restrictions on use to avoid adverse impacts.

Response: The granting of a geothermal lease is not entitlement to full, unregulated use; it carries with it specific stipulations, restrictions, and limitations to which the lessee agrees with his signature. Section 18, any special antiquities stipulations, and their contingencies are among these, and the lessee agrees explicitly to accept (and, where necessary, to pay for) the attendant inconveniences.

Comment: Page 11, c. Geothermal Resources Operational Orders, GRO Order No. 1; The reviewers express concern that USGS GRO Order No. 1, by exempting 'Casual Use' from the requirement for prior cultural resource surveys, thereby exposes cultural resources to the threat of surface collection by survey parties. They propose that each survey party must be accompanied by an archaeologist to prevent disturbance of cultural features.

Response: While the potential impact identified by the reviewers is an incontrovertible possibility, enactment of their proposed mitigation seems to us both unrealistic and inconsistant with BLM's charge as trustee of public lands. We cannot entertain the notion that geothermal survey parties are any more likely to vandalize cultural resources than any other segment of the population, or that fragile pattern surface sites would be imperiled by the presence of such parties to a degree not already posed by the general public. The hazard of "Casual Use' relates not to geothermal exploration specifically so much as it does to the general presence of people on an ancient cultural landscape. Consistant application of the protective measure proposed by the reviewers would require that every public entry upon public lands, for any purpose whatsoever, be conducted under the aegis (and watchful eye) of a professional archaeologist. Clearly, this would far exceed the rights, responsibilities, and capabilities of any Federal land management agency.

We propose as a more reasonable alternate solution that, like the problem of continued vehicular use of unimproved road beds (cf. above), areas of known or suspected high cultural resource sensitivity may be closed by separate management decision and that 'Casual Use' by geothermal suvey parties and the general

public alike may be curtailed. Moreover, we point out that the area of concern has not gone unsurveyed, and that within the proposed leasing tracts several areas are designated in the partial lease alternatives as requiring stipulations of non-occupancy. We interpret this as subsuming 'Casual Use' projects as well.

Comment: Page 12-13, GRO Order No. 4, etc.; The reviewers cite several laws and regulations in reiteration of their concern that cultural resource protective measures will be enacted solely at the discretion of USGS, and that such measures will come inappropriately late in the development scenario (i.e., after entitlement to use has been granted in the form of a lease).

Response: As we have explained above, BLM does not intend to forfeit or relinquish its responsibility for cultural resource protection to any other agency, and will continue to excercise its prerogatives of review, recommendation, and approval throughout the leasing and development cycle. Further, we maintain that required procedures have been pursued in terms of identification and evaluation of cultural resources, and protection of them (in the form of non-occupancy stipulations), as far as is possible at the present stage, before specific Plans of Operations have been proposed. As detailed above, the filing of Plans of Operations will set in motion a further sequence designed specifically to result in full compliance with the terms of 36 CFR 800.

Comment: Page 13-14, Cultural Resource Documentation; Reviewers call for compliance with SCA resolutions regarding the filing of archaeological site data and reports.

Response: SCA resolutions will be complied with fully in advance of any decision on leasing. Since publication of the Draft EAR, site data and the report have been filed with the SCA regional clearinghouse at Chico, California.

Dept. of Interior
RECEIVED
JUL 21 1977
BUREAU OF LAND MANAGEMENT
SUSANVILLE, CALFORNIA

United States Department of the Interior
FISH AND WILDLIFE SERVICE
Division of Ecological Services
2800 Cottage Way, Rm. E-2727
Sacramento, California 95825

July 19, 1977

Mr. C. Rex Cleary, District Manager
Bureau of Land Management
P.O. Box 1090
Susanville, California 96130

Dear Mr. Cleary:

Your June 3 letter requested our review and comments on the Draft Environmental Assessment Record (DEAR) for the proposed geothermal leasing of Honey Lake Valley, Lassen County, California (Wendel-Amedee Known Geothermal Resources Area). With the exceptions noted below, the DEAR is generally adequate within our area of jurisdiction and expertise. Our specific comments follow the format of the DEAR:

1. Page I-4, Location Map: Identification of highways, National Forest, and county boundaries would enable the reader to visualize the relationship of the study area with nearby landmarks.

2. All maps show caption "Wildfowl Management Area" whereas throughout the text the caption "Wildlife Management Area" is used. The correct caption is "Wildlife Area", and the appropriate change should be made on all maps and text.

3. Page II-52, Rare and Endangered Plant Species: The possible presence of endangered or threatened plant species within the project area should be considered. According to the California Native Plant Society (Special Publication No. 1, entitled "Inventory of Rare and Endangered Vascular Plants of California", 1974), Lassen County has seven plant species which the Society considers in need of special protection. Of this total, six species are under review by the Fish and Wildlife Service for possible designation as endangered or threatened species as provided by the Endangered Species Act of 1973. The six species are:

Family	Scientific Name	Common Name	Status
APIACEAE	*Lomatium ravenii*	Desert-parsley, Lassen	E 1/
BRASSICACEAE	*Arabis constancei*	Rock cress, (unnamed)	T 2/
LAMIACEAE	*Agastache parvifolia*	Agastache, small-leaved	T 2/
POACEAE	*Poa fibrata*	Blue grass, Lassen	E 1/
SCROPHULARIACEAE	*Mimulus pygmaeus*	Monkeyflower, pigmy	E 1/
SCROPHULARIACEAE	*Penstemon cinicola*	Beardtongue, Ash	T 2/

1/ Proposed for endangered status Federal Register June 16, 1976

2/ Nominated for threatened status Federal Register July 1, 1975

Because three potential endangered and three threatened plant species may exist in the project area, we recommend that the following special stipulation be made part of any lease sale: The lessee shall fund a survey of the lease area by a qualified botanist to determine the distribution of plants likely to be affected by exploratory drilling operations. A report of the survey findings should be provided to the U.S. Fish and Wildlife Service for review. Should it be determined that any endangered or threatened plant species would be adversely affected by exploratory operations, the lessee, in cooperation with the Bureau of Land Management and USFWS, shall develop and implement a plan to protect these species.

4. Pages II-55 through 77. Inconsistent usage of singular and plural form of species, e.g., mourning doves (page II-72) but Mourning Dove (page II-66).

5. Page II-61, paragraph 2, sentence 3, Birds of Prey: Delete "...annual residents..." add"...found here..."

6. Page II-62, Map 15: Delete the word "deer" from the middle bar legend.

7. Page II-66, paragraph 2. Threatened and Endangered Wildlife: Under the Federal Endangered Species Act of 1973, any species protected under provisions of this legislation is designated as either "endangered" or "threatened". However, under the California Species Preservation Act of 1970, a species is designated as "endangered" or "rare". This comment is also applicable to page IV-15, paragraph 1.

8. Page ~~IV~~III-32. We disagree with your statement "...no impacts are anticipated to the Southern bald eagle (as a result of geothermal exploration and development)." Increased human activities brought about by improved road access could impact raptor species populations. Reports from the FWS's Division of Law Enforcement indicated that the incidence of illegal shooting and trapping of bald eagles last winter more than doubled over the previous year. Because many incidents are never reported, these numbers are only a fraction of the total mortality. Geothermal leasing would cause increased public access into prime nesting raptor habitat (acknowledged to be the highest density in the Susanville District to date). Any land use decision affecting this unique habitat encompassing 7,042 acres (page MII-31) should be given the utmost consideration in response to legislative mandates such as the Endangered Species Act of 1973 and recent court decisions. Because the Southern bald eagle is a regular winter visitor to the Honey Lake area, Section 7 of the ESA is applicable, viz., "Federal agencies may not...carry out actions that will jeopardize the continued existence of a listed species...or adversely modify (the)listed species habitat..."

   In addition, the two areas utilized by migrating and wintering waterfowl if impacted by the project require special consideration because of international treaties and legislative mandates.

   Although the proposed action may affect the Fleming Unit of the Honey Lake Wildlife Area (HLWA), we recommend that the entire HLWA be excluded from present or future consideration for geothermal leasing. Under the Pittman-Robertson Act (Federal Aid in Wildlife Restoration), the California Department of Fish and Game acquired and developed these lands in the heart of one of the most significant waterfowl nesting areas of the state. The HLWA has assumed increased importance each year because wetlands are rapidly disappearing from the Central Valley and Northern California. If BLM offered geothermal leases on HLWA, strong public opposition could be expected. In addition, BLM would be required to reimburse CDF&G for the acquisition and development costs associated with HLWA.

9. Page IV-13. Mitigation measures to protect vegetation. While we readily agree that avoidance of areas containing rare (threatened) or endangered plants may be the most appropriate mitigation measure, it is not the <u>only</u> appropriate measure. The effects of geothermal operations on vegetation are not limited to the project site. For example, H_2S gas can oxidize, dissolve in precipitation, and, carried by winds, return to the earth's surface as acid rains. Based on available information, acid rains can cause injury to vegetation not only at the project site but many miles away.

10. Page VII-1 Irreversible and Irretrievable Commitment of Resources: Because fish and wildlife resources cannot be stockpiled for future use in the same manner as timber from logging operations, the annual production of fish and wildlife resources (as well as timber and other living resources) foregone during the life of the project is irretrievable. Also, the project's adverse effects on fish and wildlife resources and their habitats may not be fully reversible.

Thank you for the opportunity to review and comment on the DEAR.

Sincerely,

Felix E. Smith

Felix E. Smith
Field Supervisor

RESPONSE TO COMMENTS ON DRAFT ENVIRONMENTAL ASSESSMENT RECORD FOR HONEY LAKE VALLEY PROPOSED GEOTHERMAL LEASING

Comments from: Felix E. Smith
USDI, Fish and Wildlife Services
Division of Ecological Services
2800 Cottage Way, Rm. E-2727
Sacramento, CA 95825

Comment: Page I-4, location map.

Response: The map has been corrected.

Comment: All maps show "Wildlife Management Area" whereas throughout the text the caption "Wildlife Area," and the appropriate change should be made on all maps and text.

Response: The maps and text have been corrected.

Comment: Page II-52, Rare and Endangered Plant Species.

Response: It is felt that mitigation as proposed in the Final EAR on page IV-13 will adequately take into consideration that endangered and threatened plant species may exist in the study areas.

Comment: Pages II-55 through 77.

Response: The text has been corrected.

Comment: Page II-61, Birds of Prey, paragraph 2, sentence 3.

Response: The text has been revised.

Comment: Page II-62, Map 15.

Response: The legend "Known Summer Range - Deer and Antelope" refers to sitings of both deer and antelope; the legend "Known Summer Range - Deer" refers to sitings of deer only.

Comment: Page II-66, paragraph 2, Threatened and Endangered Wildlife, page IV-15, paragraph 4.

Response: The text has been revised.

Comment: Page III-32, Threatened and Endangered Species.

Response: Please refer to page IV-1, paragraphs 1-3, and page IV-15, Threatened and Endangered Species.

Comment: Page 3, paragraph 2 and 3, subject letter, Honey Lake Wildlife Area.

Response: Bureau of Land Management does not have reserved mineral rights beneath either Dakin or Fleming Units in the Honey Lake Wildlife Area. Surface and subsurface management rests with the State of California and California Department of Fish and Game. Also, please refer to page IV-1, paragraphs 1-3 and page IV-14, Waterfowl and Shore Birds.

Comment: Page IV-13.

Response: Refer to page IV-9, paragraph 2 and 3 in particular; and page IV-10, number 3.

Comment: Page VII-1.

Response: The rext has been revised.

LASSEN COUNTY
LAFCo

LOCAL AGENCY FORMATION COMMISSION
P.O. BOX 1088 • SUSANVILLE, CA 96130 • 74 N. LASSEN ST. • 916-257-4653

July 20, 1977

U.S. Dept. of Interior
RECEIVED
JUL 21 1977
BUREAU OF LAND MANAGEMENT
SUSANVILLE, CALIFORNIA

C. Rex Cleary
District Manager
Bureau of Land Management
P.O. Box 1090
Susanville, CA 96130

RE: Honey Lake Valley Geothermal Environmental Assessment Record.

Dear Mr. Cleary:

In reviewing those parts of the above Record which fall within the jurisdiction of the Local Agency Formation Commission, I find the following:

* Page II - 118
Second paragraph - (Housing) Wendel is a residential community with private homes and permanent residents, not all of whom work for the railroad.

There is room in the community for growth.

* Fourth paragraph -
There are elementary schools at both Litchfield and Johnstonville.

* Fifth paragraph -
There is a water and a sewer system in the Leavitt Lake Subdivision at Leavitt Lake.

* Last paragraph -
Both the Island and Wendel areas are within the Lassen Union High School District and the Lassen Community College District.

Although these are minor corrections, they are being mentioned in order for the information in the Record to be as accurate as possible.

I personally prefer Partial Lease Alternative # 2A.

Until there has been more exploration and more information received on what type and where geothermal resources are, I feel that those areas of environmental sensitivity should be protected. If it is found that these areas are needed at a later time, then is the time to decide if we should destroy them.

Respectfully yours,

Alice T. Dresel

Alice T. Dresel
Executive Officer

ATD/slw

RESPONSE TO COMMENTS ON DRAFT ENVIRONMENTAL ASSESSMENT RECORD
FOR HONEY LAKE VALLEY PROPOSED GEOTHERMAL LEASING

Comments from: Alice T. Dresel
Executive Office
Local Agency Formation Commission
P.O. Box 1088
Susanville, Ca 96130

Comment: Page II-118, second paragraph.

Response: The text has been revised.

Comment: Page II-118, fourth paragraph.

Response: The text has been revised.

Comment: Page II-118, fifth paragraph.

Response: The text has been revised.

Comment: Page II-118, last paragraph.

Response: The text has been revised.

UNITED STATES
DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY
Area Geothermal Supervisor's Office
Conservation Division, MS 92
345 Middlefield Road
Menlo Park, CA 94025

AUG 10 1977

Memorandum

To: District Manager, Bureau of Land Management
Susanville, California

From: Acting Area Geothermal Supervisor

Subject: Draft Environmental Assessment Record--Honey Lake Valley Geothermal Area

In response to your letter of June 3, 1977, the following information is submitted. Our comments and suggestions were incorporated in a satisfactory manner. The sections regarding the mitigating measures and proposed stipulations, however, leave a bit to be desired.

There is vague, or in some cases, no distinction made between those citations which are existing requirements and those which are proposed as stipulations. In many cases what appears to be a recommendation for a stipulation is repetition of existing regulations or Geothermal Resources Operational (GRO) Orders.

It is recommended that a general preamble be included in the stipulations section for all geothermal leases as follows:

"The Lessee shall comply with the following special conditions and stipulations unless they are modified by mutual agreement of the Lessee, the Supervisor and the Authorized Officer."

A. Non-living components

2. Delete. This survey is required by 30 CFR 270.34(b).

The resurvey portion of the stipulation should not be specified as a five year interval. GRO Order No. 4, Sec. 8 specifies that surveys shall be made as determined by the Supervisor.

3. Delete, see number 2, also 30 CFR 270.43.

4. Delete, this is a synopsis of the requirements of GRO Order No. 4, Sec, 8.B.

Induced seismicity. 2. Delete, this is specified by GRO Order No. 4., Sec. 8.D.

Accelerated Slope Instability, fourth line should read ". . . 270.76 and 43 CFR part 3204.1(e). These . . ."

2. Soils

1. Delete, the general portion of this stipulation is addressed by various regulation subparts and GRO Order No. 4, Section 5. The specific slope citation is inappropriate, as each site plan is evaluated on an individual basis. If the operator or lessee desires to expend sufficient funds, time and energy to establish a site which is engineeringly sound, then the possibility does exist of building in such an area.

2. Delete, see number 1.

3. Delete, this provision is made in GRO Order No. 4., Sec. 2.

4. Delete, this is a general operating provision applicable to all operations on all geothermal leases and if addressed at all should be covered in the plan of operation.

5. Delete, included in GRO Order No. 4, Sec. 2, "Operating plans shall be designed so that operations will result in the least disturbance of land, water and vegetation."

6. Acceptable, stockpiling of the topsoil is not specifically provided for.

7, 8, 9, and 10. Delete, the standards of final reclamation given here are too general and are more appropriately addressed individually to each site taking into account the conditions at the individual site.

11. If this is desired, it should be combined with stipulation 6 as a general requirement to stockpile soil in areas to be disturbed.

12, 13, 14, and 15. Delete. The reseeding techniques and requirements cited here should be addressed individually on a site specific basis.

3. Water

1. This stipulation should be changed to a requirement such as that used in The Geysers area:

"The lessee shall not disturb vegetation or soil closer than 700 feet horizontally from any perennial stream or closer than 50 feet horizontally from any intermittent stream except as authorized by the Supervisor and Authorized Officer."

2, 3, 4, 5, and 6: The revised stipulation one and GRO Order No. 4 would adequately cover all of these concerns.

7. Acceptable.

8, 9, and 10. Delete. All are general in nature and each item is already addressed by various sections of GRO Order No. 4.

11. Delete. The mud and cuttings in most sumps will require more than 90 days drying to be handled in a non-fluid state.

12 and 13. Delete, again addressed generally in GRO Order No. 4.

14. Delete, this is information to be submitted in a spill contingency plan.

4. Air and Noise

Air. First sentence should read ". . . lease terms" vice ". . . lease stipulations. . ."

Mitigating measures 1 through 5, delete. Each of these are either covered by one or more regulations or sections of GRO Order No. 4 or are more properly addressed in site specific plans of operation approval letters.

Noise. Mitigating measures 1 and 2 require levels which are overly stringent. A noise level of 55 dBa is below that of normal conversation at three feet, while 45 dBa is on the order of the noise level within a library. Normal background noise of wildlife and wind will usually exceed these levels. The current noise levels established by GRO Order No. 4 should suffice with the exception of areas where human or wildlife community disturbance occurs. In the latter event, more stringent measures may be required.

While stipulation 3 is reasonable, these various equipments are all furnished with mufflers for the sake of the operating personnel.

Stipulation 4 is acceptable.

B. Living components.

1. Vegetation.

Delete. Mitigating measures 1, 2 and 4 are already required by GRO Order No. 4.

Mitigating measure 3 should be incorporated with mitigating measures 6, 7 and 11 under A. Non living components. 2. Soils.

Stipulation 4 should be deleted. Revegetation is addressed under GRO Order No. 4, Sec. 6. Biota.

Stipulation 5 should be deleted. Installation of a sprinkler system is beyond restoration. Enhancement of the existing environment is not a reasonable requirement.

3. Wildlife.

Antelope, Mule Deer and California Bighorn Sheep. Mitigating measure 1 is reasonable, but it would seem that a seasonal restriction would be adequate.

Mitigating measure 2 is addressed directly by GRO Order No. 4, Sec. 6, and should be deleted.

Upland Game and Small Game. Mitigating measure 1 would be acceptable if the phrase ". . . unless it can be demonstrated to the satisfaction of the Supervisor and Authorized Officer that the operation will not endanger the water source." or supplant the stipulation with the version suggested in 3. Water 1.

Mitigating measure 2 will be acceptable if a clause to the effect that "The lessee will be released from all further liability for any such wells." is added.

Mitigating measures 3 and 4 appear to be citing the appropriate regulation or GRO Order and should not appear as stipulations.

The mitigating measures for the Waterfowl and Shore Birds and Birds of Prey sections are acceptable, but where feasible the affected areas should be delineated by section, township and range.

Threatened and endangered species. Mitigating measures 1 and 2 appear to be information statements rather than stipulations. These should not appear as stipulations. If a survey of some variety is to be required to satisfy these provisions of the Threatened and Endangered Species Act, we can assist by suggesting appropriate wording which has been previoulsy worked out with other BLM offices.

Human Interest Values

1. Aesthetics.

The general provisions for aesthetics in mitigating measures a through e should be addressed on an individual basis in plans of operation, or pre-plan discussions with the lessee.

Mitigating measure f should include approval of the Authorized Officer as this is the use of a resource on the leased area.

Mitigating measure g is covered in GRO Order No. 4; it should be deleted.

Mitigating measure h has already been addressed as a mitigating measure or stipulation under A, Nonliving components 2, Soils.

Mitigating measure i could be reasonable, but we are unfamiliar with this publication. Could you forward a copy for our information, please?

Mitigating measures j and k are addressed several times in various regulations and GRO Order No. 4 specifying that the lessee or operator may use only so much of the surface as necessary. It should be deleted.

Mitigating measure l is acceptable for the Class II lands on the island, but is unacceptable for those in the northern tracts. A stipulation to this effect was proposed in The Geysers area, but was revised at the Director level between USGS and BLM. The revision provided for all construction to be designed in such a manner that preserves the natural appearance of the landscape from that point. Application of this as a stipulation as currently written on the northern tracts would serve to isolate some of the outlying sections with no hope of reaching a power plant on Class III lands. Transmission of steam for power generation is generally limited to distances of a mile or less due to heat losses.

2. Recreation

Mitigating measure a would be acceptable if the construction of power plants is assessed on a site specific basis as proposed for all other permanent construction in the primitive area.

Mitigating measure b should be deleted. This generalization of all structures occurs in GRO Order 4. See recommended stipulation 1. Aesthetics. 1.

Mitigating measure c should be deleted. It has been previously pointed out that various rules and regulations restrict land use by the lessee to only so much as necessary. Fencing and access to the area of operations is addressed also by the regulations and GRO Orders.

3. Archaeological and Historical Resources

The last 2 paragraphs of the special stipulation proposed here are appropriate for geothermal leases, but the subsections (4) through (7) are essentially intra and interagency procedural supplementation and should not be included as lease stipulations.

In summary, an extensive re-write of proposed stipulations or at least clarification of which of these mitigating measures are proposed as stipulations is needed. The majority of these mitigating measures are proper field practices and could best be addressed by a pre-operation meeting between the Authorized Officer, Supervisor and lessee. Such a stipulation has been applied on many leases in the following manner:

> "Prior to the development of a Plan of Operation (43 CFR 3203.6 - 30 CFR 270.34), the Lessee shall contact the Supervisor and Authorized Officer to review local ground rules, applicable regulations, GRO Orders and pertinent special stipulations. This requirement may be waived by the Authorized Officer and Supervisor after the Lessee is thoroughly familiar with surface management problems and requirements for operations on the lease, or for specific routine operations."

We look forward to a review of the final stipulations for the proposed lease area. Should you desire clarification of any points or additional discussion, please call.

Barry A Boudreau

RESPONSE TO COMMENTS ON DRAFT ENVIRONMENTAL ASSESSMENT RECORD FOR HONEY LAKE VALLEY PROPOSED GEOTHERMAL LEASING

Comments from: Barry A. Boudreau
Acting Area Geothermal Supervisor
Conservation Division, USGS
Menlo Park, Ca 94025

Comment: Page IV-1, Non-living Components, Existing and Recommended Mitigating Measures, 2, 3, 4.

Response: The text has been revised.

Comment: Page IV-2, Induced Seismicity, 2.

Response: The text has been revised.

Comment: Page IV-2, Accelerated Slope Instability, first paragraph.

Response: The text has been revised.

Comment: Page IV-2, Soils, 1.

Response: The text has been revised.

Comment: Page IV-2, Soils, 2.

Response: The text has been revised.

Comment: Page IV-2, Soils, 3.

Response: It is felt that GRO Order No. 4, Sec. 2 is not adequately specific on this point.

Comment: Page IV-2, Soils, 4.

Response: Once again, it is felt that this particular subject is not specifically addressed in "general operating provisions applicable to all geothermal leases."

Comment: Page IV-4, Soils, 5.

Response: The text has been revised.

Comment: Page IV-4, Soils, 7, 8, 9, 10.

Response: The standards, in this case, are meant to be general. When a plan of reclamation is submitted, standards can be suited to site specific conditions.

Comment: Page IV-4, Soils, 11.

Response: The text has been revised.

Comment: Page IV-4, Soils, 12, 13, 14, 15.

Response: The text has been revised.

Comment: Page IV-6, Water, 1.

Response: The text has been clarified.

Comment: Page IV-6, Water, 2, 3, 4, 5, 6.

Response: It is felt that GRO Order No. 4 is not adequately specific on these points.

Comment: Page IV-8, Water, 8, 9, 10.

Response: It is felt that GRO Order No. 4 is not adequately specific on these points.

Comment: Page IV-8, Water, 11.

Response: The statement "unless otherwise extended by the Area Geothermal Supervisor" seems to resolve the problem.

Comment: Page IV-8, Water, 12, 13.

Response: The text has been revised.

Comment: Page IV-8, Water, 14.

Response: The text has been revised.

Comment: Page IV-9, Air and Noise, first paragraph.

Response: The text has been revised.

Comment: Page IV-10, Air, 1-5.

Response: It is felt that GRO Order No. 4 is not adequately specific about these points.

Comment: Page IV-12, Noise, 1, 2.

Response: The text has been revised.

Comment: Page IV-12, Noise, 3, 4.

Response: No comment required.

Comment: Page IV-13, Vegetation, 1, 2, 4.

Response: It is felt that GRO Order No. 4 is not adequately specific about these points.

Comment: Page IV-13, Vegetation, 3.

Response: Mitigating measure 3 is repetitious. It is under Vegetation and Soils to emphasize its importance. It will not be duplicated as a special stipuatlion on a geothermal lease form.

Comment: Page IV-13, Vegetation, 4.

Response: It is felt that GRO Order No. 4 is not adequately specific about revegetation where other than endangered and threatened species of flora or a delicate balance of flora exists in the area of operations.

Comment: Page IV-13, Vegetation, 5.

Response: The text has been revised.

Comment: Page IV-14, Wildlife, 2.

Response: It is felt that GRO Order No. 4, Sec. 6 does not directly address the situation discussed.

Comment: Page IV-14, Upland Game and Small Game, 1.

Response: The text has been revised.

Comment: Page IV-14, Upland Game and Small Game, 2.

Response: The text has been clarified.

Comment: Page IV-14, Upland Game and Small Game, 3, 4.

Response: The text has been revised.

Comment: Page IV-14, 15, Waterfowl and Shore Birds, Birds of Prey.

Response: Affected areas have been delineated by section, township and range for each alternative in Chapter VIII and are distinguished by the letter "W." Identification of raptor eyries is not indicated to prevent harrassment.

Comment: Page IV-15, Threatened and Endangered Species, 1, 2.

Response: It is felt that this is the best way to state the situation at this point in time.

Comment: Page IV-16, Aesthetics, a through e.

Response: The point is well taken. In this case the text more properly reflects enhancing measures which can be used as guidelines to develop site specific stipulations at the plan of operation stage.

Comment: Page IV-16, Aesthetics, f.

Response: The text has been revised.

Comment: Page IV-16, Aesthetics, g.

Response: The text has been revised.

Comment: Page IV-16, Aesthetics, h.

Response: It is felt this measure specifically addresses a point not made under Non-living Components, Soils.

Comment: Page IV-16, 17, Aesthetics, j, k.

Response: The text has been revised.

Comment: Page IV-17, Aesthetics, l.

Response: Where mitigating measure l applies to potential lease unit 1 in the northern tracts, the land is not leaseable under the characteristics and considerations of alternative A because of archaeological values. Under alternatives B and C, field development and production will be allowed on Class II visual resource management lands.

Comment: Page IV-17, Recreation, b.

Response: The text has been revised.

Comment: Page IV-17, Recreation, c.

Response: The text has been revised.

Comment: Page IV-18, 19, Antiquities and Objects of Historical Value, 4 through 7.

Response: The intent of such measures as 4 through 7 is as follows: The BLM is the lead agency when it comes to preparation of a geothermal EAR. As such, the general public tends to become aware of geothermal interest in a particular area through public meetings intended to make them aware of our intent. After the draft and final EAR have been published, BLM uses the Possible Mitigating and Enhancing Measures as a reference in "the process of defining site specific stipulations that will be a result of a technical examination (43 CFR Part 23) to be completed after the final EAR is published" (Page IV-1, first paragraph). Todate, Susanville District has issued competitive and non-competitive leases but in no case has activity on the leases progressed beyond casual exploration. There has not been one well drilled on a BLM geothermal lease in this District. Due to a lack of experience with the past-lease situation, we are prone to include as many points of concern as possible in the EAR. In this manner the public who reads the EAR can see for itself that BLM has considered such points and is concerned that mitigating measures be developed to address such potential problems. If it is true that items 4 through 7 are "essentially intra and interagency procedural supplementation," then there is no need to burden the lessee with extra stipulations.

United States Department of the Interior

NATIONAL PARK SERVICE

WESTERN REGION
450 GOLDEN GATE AVENUE, BOX 36063
SAN FRANCISCO, CALIFORNIA 94102

IN REPLY REFER TO:
L7619
(WR)REQ

August 30, 1977

Dept. of Interior
RECEIVED
SEP 2 1977
BUREAU OF LAND MANAGEMENT
SUSANVILLE, CALIFORNIA

Memorandum

To: District Manager, Bureau of Land Management, Susanville, California

From: Associate Regional Director, Resource Management and Planning, Western Region

Subject: Honey Lake Valley - Proposed Geothermal Leasing Draft Environmental Assessment Record

Although we did not receive an official request to review the subject document, we are enclosing the following comments on cultural resources for your consideration in preparation of the final assessment.

The subject material has adequately described cultural resources present within the Wendel-Amedee and Island Study Areas, and has satisfactorily considered impacts that may occur as a result of proposed geothermal development of the lease units. Procedures to be implemented prior to any operations under the lease, however, will not allow for adequate protection of the resources, or compliance with National Historic Preservation Act mandates. In addition, the document contains several technical errors that are in need of clarification.

Page 11-92 describes "artifact hunting" as a recreational activity. Further, the beneficial effects of new roads and trails for "those seeking easier access for artifact hunting. . ." is discussed on page III-42. These statements are inconsistent with the attitude maintained in subsequent sections that stress the importance of protecting cultural resources from vandalism and inadvertent destruction. The configuration of artifacts on the ground surface represent a fragile pattern of past human activity. To disrupt the context in which artifacts are deposited by random collection, removes information valuable in the discernment of past behavior and activities. We strongly recommend artifact hunting be deleted from consideration as a form of recreation.

The survey method employed for the Wendel-Amedee area, as described on page II-100, would not allow for adequate coverage of the area. Cultural

remains often exhibit only a minimal amount of surface evidence, which may be further obscured by vegetation and physiographic features. Traversing the terrain in 200-250 foot intervals would not allow for an accurate sample of the resources in that there would be a tendency for larger, more obvious sites to be located, while less conspicuous sites may be missed. Future surveys of the study areas should be designed to allow for complete coverage of the ground surface.

Page II-107 states that the patented lands of Lease Application 10 were not surveyed for cultural resources. Prior to the issue of a lease, Lease Unit 10 should be intensively surveyed to locate, identify, and evaluate any cultural resources that may be present.

As discussed on page IV-18, the drilling of shallow holes will be excluded from the antiquities stipulations, provided that such holes "are immediately adjacent to existing roads and trails." Drill holes, and the activity associated with the drilling procedures have the potential to disturb cultural resources that may be present, regardless of their proximity to roads. Although the stipulation may require inspection and approval by the Authorized Officer, the proposed location should be examined by a professional archeologist. Additionally, there is no discussion concerning the qualifications of the Authorized Officer, and his ability to adequately evaluate cultural resource reports submitted to him for approval.

Section 18 - Antiquities and Objects of Historic Value procedures are inconsistent with Federal regulations pertaining to cultural resources. In addition to the identification of resources and the assessment of potential impacts, as required by Section 18, each identified resource should be evaluated for its significance pursuant to National Register of Historic Places criteria. This should be accomplished in consultation with the State Historic Preservation Officer. The State Historic Preservation Officer should also be contacted to determine if there are any properties that may be pending, or eligible for inclusion in the national register.

If significant cultural resources are identified, stipulations should require that alternative locations be sought and examined, in order to preserve and, thus, protect cultural resources. It is inappropriate to require that "the lessee shall take such steps as may be required by the Authorized Officer, including archaeological salvage." Procedures for dealing effectively with cultural resources are outlined in Title 36 CFR 800, and should be incorporated into the proposed stipulations.

Specific Comments:

1. Page II-104. Reference date is missing.

2. Page III-53. Matrix numbers are missing.

3. Page II-107 states that 20 sites were recorded during the intensive survey of the island study area; however, page III-54 discusses the destruction of 29 sites that will result from total leasing of the area.

For John Adams
Bruce M. Kilgore

RESPONSE TO COMMENTS ON DRAFT ENVIRONMENTAL ASSESSMENT RECORD
FOR THE HONEY LAKE VALLEY PROPOSED GEOTHERMAL LEASING

Comments from: Associate Regional Director
Resource Management and Planning,
Western Region, National Park Service,
San Francisco, California 94102

Comment: Page II-92, Page III-42, Artifact Hunting.

Response: The text has been revised.

Comment: Page II-100, Field Methodology.

Response: While we emphasize that the traverse of each 200-250 foot survey corridor meandered to maximize coverage and allowed deflections for the examination of various anomalies, we recognize that certain categories of site (such as isolated milling stations) have probably gone undiscovered. Specifically for this reason, additional, preoperational survey is prescribed in Chapter 3 at the Plan of Operations stage when the boundaries of impact areas have been more narrowly defined.

Comment: Page II-107, patented lands of potential lease unit 10 were not surveyed for cultural resources.

Response: We concur. However, as stated in the Draft EAR (VIII-2), "The 874 acres of reserved minerals in potential lease unit 10 have not been applied for so no further administrative action will be necessary at this point in time." If application is ever made for this tract, cultural resource survey is clearly mandated. This may require judicial decision concerning the private surface owner's refusal to permit such survey, particularly if on-site disturbance is anticipated.

Comment: Page IV-18, Exclusion of shallow hole drilling from the general antiquities stipulation should require the prior examination of all such sites by a professional archaeologist.

Response: This was intended as operational procedure, but inadequately specified. Text has been revised to emphasize requirement of professional inspection.

Comment: Page IV-18, Proposed Antiquities Stipulation (Section 18) should include specific requirements to ensure compliance with 36 CFR 800 procedures regarding the protection of cultural resources.

Response: Requirements for the evaluation of site significance, consultation with the State Historic Preservation Officer, and necessary levels of impact analysis have been incorporated in all leases.

Comment: Page II-104, Reference date is missing.

Response: The text has been corrected.

Comment: Page III-53, Matrix numbers are missing.

Response: The text has been corrected.

Comment: Page II-107.

Response: The text has been corrected.

FRED LONGYEAR CO.
Management Services - Geothermal Energy Systems
408 Crocker Road Sacramento, CA 95825
(916) 489-7216/1855

September 12, 1977

Mr. Herman Kast
Assistant District Manager
Department of the Interior
Bureau of Land Management
Susanville District

Dear Mr. Kast :

The Draft Environmental Assessment Record for Proposed Geothermal Leasing, Honey Lake Valley has been reviewed. I wish to commend you for having specifically considered so-called non-electric or direct-energy uses for these particular resources.

I note that you considered above ground steel pipe with expansion loops for transmission of the geothermal fluids for these direct-energy applications. It is recommended that recent experience at Idaho National Engineering Laboratory be included in your recommendations. Based on their work, we plan to consider the use of asbestos-cement pipe, buried without expansion loops, for the Susanville and other direct-energy projects. Data from the Raft River Geothermal Project in Idaho, by INEL, (Ref. 1), indicate that buried asbestos- cement pipe is better than steel in both, installed cost and in hydaulic performance. Further, the data indicate that such applications must be installed carefully and operated in a proper manner. INEL has installed and operated this material in a 4000-ft. pipe line transporting 300°F geothermal fluids for 1-½ years of service. The installed cost is ½ that of steel and the friction loss is ½ that of steel.

For further information it is recommended that you contact Dr. Jay F. Kuntze at INEL, A/C 208-522-6640, Ext. 1781. Mr. Howard D. Harvey, Johns-Manville Sales Corporation, 3 Stewart Court, Moraga, CA 94556, telephone A/C 415-362-4353, has performance, installation, cost and system performance data for the J-M A/C pipe.

Based on contacts and data received from the above sources plus results of analyses conducted on the Susanville Geothermal Energy Project, it is believed that such buried A/C pipe lines should result in, not only a cost reduction and a performance improvement over steel, but also in a reduction in environmental impact intensity for direct-energy applications in the Honey Lake Valley area.

Sincerely,

Alfred B. Longyear

Alfred B. Longyear

cc: Dr. J. F. Kuntze,
I N E L
H. D. Harvey,
Johns-Manville
J. C. Jeskey,
City of Susanville

Reference 1 :
L. G. Miller, J. F. Kuntze, R.D. Sanders, "Asbestos - Cement Pipeline Experience at the Raft River Geothermal Project", (Rough Draft), TREE-1114, April 1977, EG&G Idaho, Inc.

OFFICE OF THE SECRETARY
RESOURCES BUILDING
1416 NINTH STREET
95814
(916) 445-5656
Department of Conservation
Department of Fish and Game
Department of Navigation and Ocean Development
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EDMUND G. BROWN JR.
GOVERNOR OF CALIFORNIA

Air Resources Board
Colorado River Board
San Francisco Bay Conservation and Development Commission
Solid Waste Management Board
State Lands Commission
State Reclamation Board
State Water Resources Control Board
Regional Water Quality Control Boards
Energy Resources Conservation and Development Commission

THE RESOURCES AGENCY OF CALIFORNIA

SACRAMENTO, CALIFORNIA

SEP 26 1977

Mr. Ed Hastey, State Director
Bureau of Land Management
Federal Office Building, Room E-2841
2800 Cottage Way
Sacramento, CA 95825

Dear Mr. Hastey:

The State of California has reviewed the "Draft Environmental Assessment Record, Proposed Geothermal Leasing, Honey Lake Valley" (SCH 77061432), transmitted to the Office of Planning and Research in the Governor's Office.

Although the Draft EAR is generally well done, it does not adequately address a number of concerns, including two of special significance. First, approval of the BLM geothermal leasing program as proposed could effectively prevent the inclusion of lands into the proposed Skedaddle-Amedee Mountains Primitive Area and a California bighorn sheep reintroduction site. Because premature approval would preclude important management options, geothermal leasing should only be considered after decisions are made regarding less intensive uses.

In addition, the Draft EAR does not propose adequate mitigation and compensation for the loss of wildlife habitat that geothermal exploration and development would cause. As a result, there is significant potential for long-term adverse impacts on California's fish and wildlife resources. This apparent policy creates direct conflicts among BLM policy, California law, and NEPA.

We recommend, therefore, that an Environmental Impact Statement be prepared for this proposed geothermal leasing. The EIS should contain the following measures for protecting fish and wildlife while allowing geothermal development in portions of the Wendel-Amedee Study Area:

1. Exclusion of all lands north and east of the 4,040 foot contour as depicted on Map 8 of the draft EAR from leasing. This boundary could be subject to minor fluctuations, depending on the resources present. Exclusion of these lands would virtually eliminate adverse impacts to a large majority of the fish and wildlife resources.

2. No surface disturbance within one-half mile of the Honey Lake Wildlife Area; no power plant construction within one mile of it.

3. No surface disturbance within one-half mile of waterfowl and shorebird nesting and wintering areas.

4. No surface disturbance within 700 feet of any existing surface water used by wildlife.

5. No surface disturbance within one-half mile of any identified raptor eyries. An additional one-half mile "no disturbance" zone required from February 1 to September 1 of each year. No power plant construction within one mile of identified raptor eyries.

6. Adequate mitigation and compensation measures implemented concurrently with any development program.

The attachment to this letter, which details these and other concerns, should be considered a part of this response.

Thank you for the opportunity to review and comment.

Sincerely,

Richard E Hammond, Deputy Secretary,

for Secretary for Resources

cc: Director of Management Systems
State Clearinghouse
Office of Planning and Research
1400 Tenth Street
Sacramento, CA 95814
(SCH No. 77061432)

Bureau of Land Management
Department of the Interior
P.O. Box 1090
Susanville, CA 96130

DETAILED COMMENTS
on the
DRAFT EAR
HONEY LAKE VALLEY
GEOTHERMAL ACTIVITY AREA

FISH AND WILDLIFE

1. We note that the BLM's decision to lease lands within the proposed lease area will be made before the boundaries of the proposed Skedaddle-Amedee Mountains Primitive Area and a California bighorn sheep reintroduction site are determined. We urge the Bureau in its geothermal decision-making process to consider the extreme importance of these two areas for wildlife and the implications of leasing with respect to future management options and capabilities. For example, geothermal leasing may preclude the former area's ultimate designation as a primitive area or the latter area's suitability as a reintroduction site for California bighorn sheep.

2. Although we agree that excluding areas from leasing and establishing buffer zones and time constraints are a form of mitigation, they do not address the need to compensate for the loss of wildlife habitat resulting from geothermal activities.

   Construction of access roads, drilling pads, waste sumps, power plants, electrical transmission lines, and other appurtenances are adverse impacts which the Draft EAR assesses, but for which it does not provide adequate mitigation or compensation. The final EAR should contain a detailed discussion of such measures that would be implemented by the leasee, the leasor, or both. For example, the dedication of federal lands within or adjacent to the lease area would protect habitat for use by wildlife displaced by the project. Suitable benefits to populations of big game, waterfowl, shorebirds, upland game, and raptors and their prey could be provided by such techniques as water development, brush manipulation, establishment of vegetation more desirable to specific species of wildlife, etc.

3. Much of the proposed lease area is important for fish and wildlife oriented recreational use, principally hunting. The Honey Lake Wildlife Area is annually used by many waterfowl hunters (4,000 in the 1976-77 season) as well as upland game hunters. Portions of the shore of Honey Lake are important waterfowl hunting areas. Most of the canyons and slopes of the Amedee Mountains are important chukar and rabbit hunting areas, as are portions of the Skedaddle Mountains. Deer hunters use portions of the Skedaddle and Amedee Mountain ranges.

   The Draft EAR's brief discussion of the adverse impacts of geothermal development on fish and wildlife-oriented recreational use should be expanded to include the potential for reducing hunting opportunity by reducing access. Within any given lease, it is our understanding the leasee would have the authority to prevent public entry in order to protect equipment, facilities, or for safety reasons (e.g. discharge of firearms). If this

were to occur, these lands would no longer be available for hunting. This adverse impact could become quite significant if the area excluded from public entry included an important access road to other hunting areas.

The Final EAR should also include a discussion of mitigation measures proposed for minimizing adverse impacts on fish and wildlife-oriented recreational use. The most effective method would of course be to exclude key hunting areas from leasing and to create suitable buffer zones. The area to which leasees could prevent public entry could also be limited to areas already developed.

4. The fisheries section (page 11-77) should be expanded to indicate the fishery values in the lower Susan River, ponds and canals within the Honey Lake Wildlife Area (Fleming Unit), and various agricultural waterways. These waters support such gamefish as largemouth bass, brown bullhead, black crappie, Sacramento perch, and bluegill and pumpkinseed sunfish. Principal nongame fish are redside shiner, Lahontan sucker, and speckled dace. Honey Lake supports limited populations of game and nongame fish in springs adjacent to the Honey Lake Wildlife Area (Fleming Unit) and along the east and southwest margin of the lake. Size of the fish populations in the lake fluctuates depending on water quantity and quality. Fish species composition within the lake is not well known but fishermen reportedly caught brown bullhead within the lake in the early 1970's before it went dry. Other gamefish found in the lower Susan River have not been reported from the lake.

Geothermal development could adversely impact the comparatively limited fishery resources of this area if toxic geothermal fluids were to enter watercourses. On the other hand, if drilling activities encountered potable water near the surface or if the geothermal fluids at depth are of suitable quality, they could be put into watercourses or Honey Lake, thereby enhancing fishery values.

In fact, Page III-9, first paragraph, emphasizes the positive impacts of geothermal development on agriculture if the toxic constituents of geothermal fluids are removed. Fish and wildlife should be given equal consideration in the use of such water. The tremendous potential benefit for fish and wildlife of this arid area includes development of waterfowl and shorebird nesting and wintering habitat, fishing ponds and drinking water for big game, upland game, and nongame species such as songbirds, rodents, etc.

AIR QUALITY

1. The BLM should be aware of the Air Conservation Program being developed by the Air Resources Board. Under this program, measures are to be implemented to protect air resources where the air quality is presently superior to existing standards. Although the precise details of this program have yet to be developed, the BLM is encouraged to follow its progress.

2. The table on page I-33 lists the toxicity threshold levels for several gases commonly found in geothermal fluids. No exposure time is indicated for the concentrations and no source is cited. The toxicity level for humans for hydrogen sulfide (H_2S) is 10 ppm for an eight-hour period, not 20 ppm as given in the table.

3. On pages III-12 to III-15, the Draft EAR contains a discussion of the possible effects of various gases which have been encountered in geothermal fluids, analyzing the impacts on receptors in general terms. This section should include a description of the specific types of possible sensitive receptors and their location in Honey Lake Valley, e.g., human settlement, crops, and natural vegetation. Emphasis should be on sensitivity to H_2S.

4. On page III-12 the Draft EAR indicates the potential for significant increases in emissions of fugitive dust which would result from considerable surface disturbance during exploration and construction activities. We cannot agree with the statement that "...this impact on the overall air quality is lessened by the fact that under existing conditions a considerable amount of dust is blown into the air during high winds." To the contrary, the existence of a fugitive dust problem in Honey Lake Valley may render even more acute the significance of additional emissions increases.

5. The description of the existing fugitive dust problem downwind of Honey Lake (page III-19) indicates that the expected additional 720 acres of devegetated soil will not add significantly to the problem. This should be substantiated with a quantitative analysis including projections of emissions and ambient air concentrations.

6. The discussion of existing air quality levels which begins on page II-34 should include a summary of the measurements for total suspended particulates (TSP) at the Susanville air monitoring station. The State annual standard for TSP has been exceeded at the Susanville station in recent years.

7. The analysis of air quality impacts of electric power generation (pages III-11 to III-15) should include a discussion of the emissions associated with a closed binary system as compared to "flash" systems. The cooling water requirements for these power generation uses should also be discussed in the report.

8. On page III-19, the Draft EAR states "Particulate matter and noxious gases contributed to the atmosphere by the wells on individual leasing units should not vary significantly from leasing unit to leasing unit since all wells will be similar. and production should be from the same geothermal reservoir." To the contrary, it is more likely that the concentrations of chemical compounds in the fluid will vary widely from well to well. For this reason, each geothermal developer should be required to perform an analysis of the noncondensible gases in the fluid after the well has been cleaned out. A copy of the analysis should be transmitted to the Lassen County Air Pollution Control District.

9. Because of the variable properties of the geothermal fluid among various lease areas, we question the statement (page III-23) that:

> "The impacts on air quality from venting steam into the atmosphere will be the same as covered on leasing units 1-7."

10. Although the mitigation measures listed on page IV-10 appear basically sound, Item No. 4, prohibiting the venting of wells when meteorological air stagnation is severe, would likely be difficult to enforce. In Item No. 5, the air monitoring stations should require as a minimum, measurements of wind and concentrations of H_2S and suspended particulates. These are at least as significant as temperature and humidity. Also, the GRO Orders regulating air pollution for geothermal development (listed in Table 72) should be summarized in the Final EAR.

WATER RESOURCES

1. The last sentence of paragraph six (page I-30) should include a statement to the effect that the blow-outs are usually killed by water flooding prior to sealing the concrete.

2. The second sentence of the second paragraph (page V-I) should be changed to read "...proven successful when carefully engineered and monitored in other..."

GEOLOGY AND SEISMICITY

1. The "Constituents carried in the steam from wells at The Geysers Field" (Table 8, page I-34) cannot be compared to those possible at Honey Lake (page I-33) because of the great differences in the systems (higher temperature vapor vs. lower temperature water-dominated) and because of major differences in the geology of the two areas.

2. On page II-7 reference is made to microearthquakes in the M2 to 4 ranges. It is more usual to classify microearthquakes as less than M 2½ or at most M 3.

3. On page II-9 under slope stability, the comment is made that "Slopes in the northeast part of the Wendel-Amedee area range from approximately 4 to 8½ degrees". A measurement made from Map 8, "Honey Lake Valley Geothermal Study Area Topography", shows that slopes as steep as 40 degrees are present in that area, particularly in sections 21, 28, and 33 in T29 N, R 16 E. If any facilities are to be located in these sections or in or near section 13, T 29 N, R 15 E, then careful consideration should be given to potential slope stability problems.

4. For purposes of detecting induced seismicity (pages III-2 and IV-2), a monitoring system should be installed prior to any development and maintained throughout the life of the project, particularly in the early stages.

   With adequate planning mineral resource development can be carried on in a manner compatible with geothermal development. The statement on page III-3 that a potential for extensive mineral deposits exists in the rocks underlying the volcanic rocks makes this factor all the more important.

5. The geology section (page III-3) should briefly mention the impact of subsidence associated with geothermal development on operation of the Honey Lake Wildlife Area. Should this occur, serious problems would be experienced with some marsh management and farming areas where dikes, water structures, ground level, and slope are very critical.

6. Page III-3: First paragraph. Caution must be exercised whenever fluids are injected into a zone with a low pore pressure or a zone that had large volumes of fluid withdrawal. Pressure parting (fracturing) can occur and the fracture will be normal to the least geologic stress.

ENERGY DEVELOPMENT

The report points out that geothermal energy can be used for electric power generation. The Geysers Power Plant, operated by Pacific Gas and Electric Company, is an example of the commercial development of a dry steam geothermal field. Because the development of a hot-water geothermal system in an economic manner would add to California's energy resources, this type of exploratory program should be encouraged. The State generally favors the development of geothermal resources, if adequate environmental safeguards are required at all stages.

If additional transmission lines are required to export power (page I-45) they may be subject to regulation by the California Public Utilities Commission.

REVIEW PROCEDURES

Review of this draft Environmental Assessment Record has been coordinated with the Departments of Conservation, Fish and Game, Food and Agriculture, Health, Parks and Recreation, Transportation, and Water Resources; the Air Resources Board, the State Water Resources Control Board, the Solid Waste Management Board, the Energy Resources Conservation and Development Commission, the Public Utilities Commission, and the State Lands Division.

RESPONSE TO COMMENTS ON DRAFT ENVIRONMENTAL ASSESSMENT RECORD FOR THE HONEY LAKE VALLEY PROPOSED GEOTHERMAL LEASING

Comments from: The Resource Agency of California
Sacramento, California 95814

Comment: Page 1, second paragraph, approval of geothermal leasing could prevent the inclusion of lands into the proposed Skedaddle-Amedee Mountains Primitive Area.

Response: The possibility of conflict between the proposed Skedaddle-Amedee Primitive Area, now referred to as the Skedaddle-Amedee Wilderness Study Area, has been discussed in the final EAR. Refer to Wilderness Summary preceding Chapter I. According to a Solicitor's opinion sent to the Director of BLM in a memo dated May 23, 1977, "study areas should be managed so as to preserve their wilderness characteristics but all current activities can continue subject to controls in order to protect wilderness characteristics." See page II-42 for more detail. Essentially, our personnel have considered the potential impacts and have written mitigation to protect the proposed wilderness study area from unmitigatible impacts that could cause it to be excluded from future wilderness designation. See page IV-17.

Comment: Page 1, second paragraph, approval of geothermal leasing could prevent the reintroduction of California bighorn sheep in the Amedee Mountains.

Response: The proposed release site is in Section 22 NE¼, T.29N., R.16E., in Wendel Canyon. At present, there is not a pending non-competitive geothermal lease application for this area. At such time, if bighorn sheep reintroduction is still a viable proposal, the potential impact of retaining this particular release site will be evaluated, if the potential for conflict exists. Section 22 and the surrounding area (see Map 25) are included in the roadless study area. Until the final decision on wilderness designation is made, these lands will be managed as described in the first response and as discussed on page II-42. Essentially, it is highly unlikely that BLM would allow a situation to develop which will eliminate the possibility of the Skedaddle-Amedee Mountains as a reintroduction site for bighorn sheep.

Comment: Page 1, third paragraph, the Draft EAR does not propose adequate mitigation and compensation for the loss of wildlife habitat that geothermal exploration and development would cause.

Response: BLM's position concerning wildlife mitigation and compensation for loss of wildlife habitat has recently been relayed to Mr. Charles Fullerton, Director, Department of Fish and Game, Sacramento in a letter from our State Director, Mr. Ed Hastey, dated August 23, 1977. Essentially, "by doing an EAR, we determine which lands will be excluded from leasing due to significant environmental impacts. A big factor in the process is the identification of those lands which would <u>not</u> be offered for lease because of significant, unmitigatable impacts. The purpose of the EAR is, therefore, to identify only those tracts which could sustain geothermal development without significant environmental impact. If it is determined to lease areas where significant environmental impact could occur, then a decision approach to specific wildlife mitigation for tracts offered for lease, we feel that impacts are insignificant or mitigatable "on site". In addition, we have no authority to require off site mitigation. We also feel that stringent mitigation should accomodate the species impacted in place and not substitute another habitat type/species in trade, i.e., desert tortoise for duck habitat trade offs. Thus, we cannot imply mitigation by enhanced wildlife habitat under other ongoing programs."

Comment: Page 1, fourth paragraph, an EIS should be prepared for proposed geothermal leasing.

Response: The need for an environmental statement is based only on: (1) the existence of controversy with respect to the proposed action or project; or (2) the potential for significant impact(s) on the human environment resulting from implementation of the proposed action (see NEPA, P.L. 91-190; CEQ Guidelines, 1973, 51500.6(a)). The determination of controversy and significant impacts will be made by the responsible official and will be set forth in a memorandum separate from the EAR (BLM Manual 1791.26).

Reference to your letter indicates that you feel "approval of the BLM geothermal leasing program as proposed could effectively prevent the inclusion of lands into the proposed Skedaddle-Amedee Mountains Primitive Area (Now a Roadless Study Area under interim management) and a California bighorn sheep reintroduction site." Both items have been adddressed in previous responses. It is felt that both issues have been adequately considered and mitigation has been proposed that will resolve any conflicts that could develop.

Further, the issue of adequate mitigation and compensation for loss of wildlife habitat has also been addressed in a previous response.

Essentially, the most apparent grounds for an EIS, the potential for significant impact which would cause the Skedaddle-Amedee Mountains Primitive Area not to be designated a Wilderness Area or the elimination of the Skedaddle-Amedee Mountains as a bighorn sheep reintroduction site, are not felt to exist. It is felt that these issues have been dealt with and adequate mitigation can and will be implemented.

It should be noted that your recommended measures for protecting fish and wildlife while allowing geothermal development in portions of the Wendel-Amedee Study Area have, in most instances, already been incorporated in the alternatives to the proposed action, Chapter VIII.

Comment: Page 2, #1.

Response: It is felt that BLM's resource inventory has adequately identified fish and wildlife resources and that impacts and appropriate mitigation measures have been proposed in the Draft EAR.

Comment: Page 2, #2.

Response: The first part of the measure is already included in Chapter IV under Waterfowl and Shore Birds. The second point has been adopted.

Comment: Page 2, #3.

Response: This stipulation is already part of partial lease alternative 2A, under Waterfowl and Shore Bird Habitat.

Comment: Page 2, #4.

Response: It is felt that this measure has been adopted under Upland Game and Small Game for each partial lease alternative.

Comment: Page 2, #5.

Response: This stipulation is already part of partial lease alternative 2A, under Birds of Prey (Raptors).

Comment: Page 2, #6.

Response: The point is well taken.

Fish and Wildlife

Comment: Page 3, #1.

Response: The issues have already been discussed above. The points are well taken.

Comment: Page 3, #2.

Response: The issue has already been discussed above.

Comment: Page 3, #3.

Response: The issue of reduction of recreational access and access in general is specifically addressed in USGS GRO Order No. 4, Sec. 3, Public Access and Sec. 4, Recreation and under BLM's own regulations, 43 CFR 3204.1(b). Reference to these regulations will indicate that public and recreational access is adequately protected.

Comment: Page 4, #4, first paragraph.

Response: The text has been clarified.

Comment: Page 4, #4, second and third paragraph.

Response: The points are well taken.

Air Quality

Comment: Page 5, #1.

Response: The point is well taken.

Comment: Page 5, #2.

Response: Reference to the source for this table does not indicate a credit nor an exposure time.

Comment: Page 5, #3.

Response: It is felt that the discussion of the possible effects of various gases and the impact on receptors is adequate.

Comment: Page 5, #4.

Response: It is felt that mitigation has been proposed that will deal with this problem. See Chapter IV, Air & Noises.

Comment: Page 5, #5.

Response: The qualitative requirements of an EAR do not require such detailed analysis.

Comment: Page 5, #6.

Response: There were no figures given for total suspended particulates (TSP).

Comment: Page 6, #7.

Response: It is felt that a detailed discussion of each partiuclar type of generation system and its associated level of gaseous emissions is not required. Impacts have been identified and mitigation measures developed that should be adequate for any generation system employed.

Comment: Page 6, #8.

Response: Under existing regulations USGS Geothermal Resources Operational Orders #4, Sec. 9-A3, Air Quality, 30 DFR 270.41, Pollution and 43 CFR 3204.1-3(c), Air Pollution, the lessee shall comply with and shall not exceed all Federal, State and regional air pollution standards. It is felt that these regulations are adequate.

Comment: Page 6, #9.

Response: Until more data is available concerning the properties of the geothermal reservoir and its fluid properties, the response to the above comment will be deemed sufficient to handle the situation.

Comment: Page 6, #10, item No. 4.

Response: Noncompliance with regulations or lease terms, addressed under 30 CFR 270.80, and Cancellation of lease for noncompliance with regulations or lease terms, under 43 CFR 3244.3, deal with this situation should it arise.

Comment: Page 6, #10, item No. 5.

Response: What must be measured at an air monitoring station will be included in a plan of operation required under 30 CFR 270.34 j & k, 270.41, and 43 CFR 3203.6.

Comment: Page 6, #10, reference to GRO Orders.

Response: A copy of Geothermal Resource Operational Orders (GRO) is available with the USGS.

Water Resources

Comment: Page 7, #1.

Response: The text has been corrected.

Comment: Page 7, #2.

Response: The text has been corrected.

Geology and Seismicity

Comment: Page 7, #1.

Response: The point is well taken.

Comment: Page 7, #2.

Response: Geologic and seismic data for this EAR was supplied by USGS, Menlo Park.

Comment: Page 7, #3.

Response: The point is well taken. The text has been corrected to read "northwest" instead of "northeast".

Comment: Page 7, #4.

Response: Reference is made to 30 CFR 270.34(k) concerning collection of data prior to any development, and 30 CFR 270.34(j) concerning provisions for monitoring throughout the life of the project. GRO Order #4, 8D also refers to seismicity and monitoring of geothermal development.

Comment: Page 7, #5.

Response: The text has been clarified.

Comment: Page 8, #6.

Response: The point is well taken.

Honorable Huey Johnson Secretary for Resources Resources Agency 1416 9th Street, Room 1311 Sacramento, Ca 95814	August 1, 1977 DSIS-SCH 77081432 Proposed Geothermal Leasing, Honey Lake Valley, Lasen County

Attention: L. Frank Goodson

The Office of Historic Preservation has reviewed the Draft Environmental Assessment Record prepared by the Susanville District Office of the USDI Bureau of Land Management for the proposed Geothermal Leasing of areas in Honey Lake Valley, Lassen County.

The cultural resource assessment performed to date exhibits a high degree of professionalism, foresight and sensitivity. In form and substance, the assessment is highly praiseworthy.

We are also very pleased to note that the preliminary assessment and intensive surveys were completed prior to a decision to lease. In our estimation, this is entirely consistent with the provisions of the National Environmental Policy Act, the National Historic Preservation Act of 1966 as amended, Executive Order 11593 and 36 CFR 800. It provides the minimum baseline data needed to make intelligent decisions in the areas of resource management and preservation in timely fashion. We concur particularly with stipulations 1 and 2 on page IV-17 insofar as they strongly advocate on-site resource preservation; we expect that these stipulations will be enforced and that potential lessees will be made fully aware of them.

Beyond this, the staff to the State Historic Preservation Officer looks forward to assisting the Bureau of Land Management with its expressed intent to comply fully with the family of legislation referenced above and in a manner which will secure the integrity of the resources to the maximum extend possible, (DSIS IV-17 through 19).

Should you have any questions concerning this review, please contact Hans Kreutzberg, Office of Historic Preservation, by calling (916) 322-8700.

Original Signed by
Dr. Knox Mellon

Dr. Knox Mellon
Historic Preservation Coordinator

James P. Tryner, Chief
Resource Preservation and
Interpretation Division

cc: Advisory Council on Historic Preservation

XI. PARTICIPATING STAFF

Bureau of Land Management Staff

Susanville District Staff

Adams, Myron	Soils and Water
Barbour, Lynda	Typist
Bullock, Arnold	Vegetation
Carroll, Tim	Geology
Cleary, Rex	District Manager
Corson, Christopher	Archaeology and Cultural Resources
Farrace, Carmie	Records Management
Kast, Herman	Assistant District Manager
Kingston, Connie	Letters and Public News Releases
McFarlan, Joseph	Team Leader, Technical Coordinator
Melton, Jim	Environmental Coordinator, Editing
Morse, Mark	Area Manager, Public Involvement
Schoolcraft, Gary	Air, Climate and Noise
Walker, Robert	Wildlife
Weiskircher, George	Aesthetics and Recreation
Woods, Lynn	Typist

Bureau of Land Management State Office

Bays, Dale	Socio-Economics
Grobman, Sue	Technical Writer, Editor
Kleinsmith, Doug	Natural Resource Specialist

U.S. Geological Survey - Menlo Park

Conservation Division	
Furman, Marvin	Geology

1. ________________, 1975, In Energy Alternatives, A Comparative Analysis. CEQ, ERDA, EPA, FEA, FPC. DOI, NSF.

2. ________________, 1975, In Environmental Analysis Record, Surprise and Warner Valleys, Proposed Geothermal Leasing. USDI, Bureau of Land Management, Susanville District, California, Lakeview District, Oregon.

3. ________________, 1976, In Environmental Analysis Record, Randsburg, Spangler Hills, South Searles Lake, Proposed Geothermal Leasing. USDI, Bureau of Land Management, Riverside District, California.

4. ________________, 1976, In Environmental Analysis Record, The Upper Pit River Area, Proposed Geothermal Leasing. USDA, Forest Service, Modoc National Forest, Alturas, California and USDI, Bureau of Land Management, Susanville District, California.

5. ________________, 1976, In Workshop Proceedings, Final Technical Report, Susanville Geothermal Energy Project. ERDA and City of Susanville, California.

6. Allen, Clarence R., 1974, Geological Criteria for Evaluating Seismicity. GSBA, v. 86, p. 1041-1057.

7. Amesbury, R.H., 1964, Gateway to an Empire. Lassen County Histroical Society Publication. Susanville, California.

8. Amesbury, R.H., 1967a, Nobles' Emigrant Trail. Susanville, California.

9. Amesbury, R.H., 1967b, The Search for Water in the Honey Lake Valley. Lassen County Historical Society, Bulletin 17. Susanville, California.

10. Amesbury, R.H., 1971, Eagle Lake.

11. Barmettler, Edward R., 1976, Geothermal Energy Utilization. In Susanville Geothermal Energy Workshop Proceedings, Susanville Geothermal Energy Project, July 1976. Susanville, California.

12. Bedwell, S.F., 1970, Prehistory and Environment of the Pluvial Fort Rock Area of South Central Oregon. Unpublished Ph.D. dissertation, University of Oregon, Eugene, Oregon.

13. Bellrose, F.C., 1976, Ducks, Geese and Swans of North America, Wildlife Management Institute.

14. Bent, A.C., 1961, Life Histories of North American Birds of Prey, Parts I and II, Dover Publications, Inc.

15. Brady, Nyle C., 1974, The Nature and Properties of Soils, 8th Edition, MacMillan Publishing Co., Inc., New York, p. 564.

16. Brioli, C.J., 1974, Technical Report on Geothermal Energy Development in South Central Oregon, Northeastern California and Northwestern Nevada. In Environmental Analysis Record, Surprise and Warner Valleys, Proposed Geothermal Leasing. USDI, Bureau of Land Management, Susanville District, California, Lakeview District, Oregon.

17. Busby, C.I., 1976, An Archaeological Survey of Selected Areas of Honey Lake Island, Lassen County, California. Report Filed at USDI, Bureau of Land Management, Susanville District, California.

18. California Department of Finance, Population Projections for California Counties 1975-2020. Alternative Series, D-100, E-0, D-150, C-150, Report 74-P-Z, Sacramento, California, June 1974.

19. California Department of Parks and Recreation, 1976, California Inventory of Historic Resources. Sacramento, California.

20 California Department of Parks and Recreation. CORRP 74, California Outdoor Recreation Resources Plan, February 1974, 188 p.

21. California Department of Water Resources Bulletin, Northeastern California, Vol. 2, No. 130-71, 1972.

22. California Department of Water Resources, Northeastern Counties Ground Water Investigation. Bulletin No. 98, Volume II, 1963.

23. California Department of Water Resources, Northeastern Counties Investigation. Bulletin No. 58, 1960.

24. California Department of Water Resources, Part 1 Surface Water Records. Vol. 2, Northern Great Basin and Central Valley, 1974.

25. California Department of Water Resources. Water and Power from Geothermal Resources in California, An Overview, Bulletin No. 190, December 1974.

26. California Department of Water Resources Bulletin, Northeastern California, V. 2, No. 130-74.

27. California Employment Development Department, Lassen County Labor Market Newsletter, San Francisco, California, April 1976.

28. California State Water Resources Control Board, Water Quality Control Plan Report, North Lahontan Basin, 1975.

29. Chasteen, A.J., 1974, Geothermal Steam Condensate Reinjection. In Proceedings of the Conference on Research for the Development of Geothermal Energy Resources. September 23-25, 1974, Pasadena, California, JPL/Cal Tech, NSF.

30. Crustal Strain and Fault Movement Investigation. Los Angeles Department of Water Resources, Bulletin, 116-Z, 1964.

31. Dasmanor, Wildlife Biology, John Wiley and Sons, New York, 1964.

32. Dictionary of Geological Terms, Dolphin Books, Doubleday and Co., New York, 1962.

33. Diller, J.S., 1908, Geology of the Talyorsville Region, California USGS Bulletin 353, 128 p.

34. Fairfield, A.M., 1916, Pioneer History of Lassen County. San Francisco, California.

35. Felton, Ernest L., 1965, California's Many Climates.

36. Fenenga, F., and F.A. Riddell, 1949, Excavation of Tommy Tucker Cave, Lassen County, California. American Antiquity 14:203-214.

37. Gianella, V.P., 1975, Earthquake and Faulting, Fort Sage Mountains, California. December 1950, BSSA, v. 47, No. 3, p. 173-177.

38. Hannah, Judith C., The Potential of Low Temperature Geothermal Resources in Northern California, California Division of Oil and Gas, Report No. TR13, 1975.

39. Hardt, W.F., F.H. Olmstead, and F.W. Trainer, 1975, Susanville-Honey Lake Geothermal Reconnaissance, Southern Lassen County, California. USGS, unpublished report for proposal for further geothermal investigations submitted for approval to U.S. Bureau of Reclamation.

40. Healy, J.H., W.W. Ruby, D.T. Griggs, and C.B. Raleigh, 1968, The Denver Earthquakes. Seismic, v. 161, p. 130101310.

41. Hester, T.R., 1973, Chronological Ordering of Great Basin Prehistory. University of California Archaeological Research Facility, Contribution 17. Berkeley, California.

42. Hester, T.R., and R.F. Heizer, 1973, Great Basin Projectile Points: Forms and Chronology. University of California Archaeological Research Facility, Non-serial publication. Berkeley, California.

43. Hilton, G.S., 1963, Water Resources Reconnaissance in Southeastern Part of Honey Lake Valley, Lassen County, California. USGS, WSP, 1619-Z, 8 p.

44. Hudson, Ivan. Personal communication, Susanville, California. 1976.

45. Hydrologic Data. 1974, v. 2, Northeastern California. California Department of Water Resources, Bulletin No. 130-74, 1976.

46. Ingles, L.G., 1965, Mammals of the Pacific States, Stanford University Press.

47. Johnsgard, P.A., North American Game Birds of Upland and Shoreline. University of Nebraska Press, 1975.

48. Lamb, S.M., 1958, Linguistic Prehistory in the Great Basin. International Journal of American Linguistics 24:95-100.

49. Lassen County Agricultural Commissioner, Lassen County 1975 Crop Report, Susanville, California. 1976.

50. Lassen County, Overall Economic Development Plan. Susanville, California, June 1976.

51. Lassen County Historical Society, 1961, The Honey Lake Basin Ecumine of Northeastern California.

52. Lassen County Transportation Commission, Regional Transportation Plan and Final Environmental Impact Report, Lassen County. Adopted on April 1,1975.

53. Lawrence, Art. Personal communication, Susanville, California. 1976.

54. Lawson, R., California Department of Water Resources, Personal communication, May 1976.

55. Martin, J.C., 1975, The Effect of Fluid Pressure on Effective Stresses and Induced Faulting. Jour. of Geophys. Res., v. 80, No. 26, p. 3783-3785.

56. Middleton, R.A., 1963, The Honey Lake Basin Ecumine of Northeastern California. Lassen County Historical Society, Bulletin 15, Susanville, California.

57. Miller, William B., 1973, "Application of Reclamation Techniques to Oil and Gas Surface Construction." Wyoming Geological Association Guidebook, p. 225-238.

58. Moody, Robert. Personal communication, Susanville, California. 1976.

59. Myrick, D.F., 1963, Railroads of Nevada and Eastern California. Berkeley, California.

60. Nathenson, M. and L.J.P. Muffler, 1975, Geothermal Resources in Hydrothermal Convection Systems and Conduction Dominated Areas. In Assessment of Geothermal Resources of the United States. USGS Circ. 72G, p. 104-121.

61. National Oceanic and Atmospheric Administration, Environmental Data Service. Climatological Data, Annual Summary, 1956-1975.

62. O'Connell, J.F., 1971, The Archaeology and Human Ecology of Surprise Valley, Northeast California. Unpublished Ph.D. dissertation, University of California, Berkeley, California.

63. Peterson, R.T. A Field Guide to Western Birds, Houghton Mifflin Company Boston, 1961.

64. Powell, Robert W., ed. 1974. Inventory of Rare and Endangered Vascular Plants of California. California Native Plant Society.

65. Procunier, R., 1976, Division of Air and Hazardous Materials, Environmental Protection Agency, San Francisco, California, Personal communication.

66. Raleigh, C.B., 1972, Earthquakes and Fluid Rejection in Underground Waste Management and Environmental Implications. AAPG Memoir 18, p. 273-279.

67. ____________________, J.H. Healy, and J.D. Bredehoeft, 1973, Faulting and Crustal Stress at Rangely, Colorado. In Flow and Fracture of Rocks. AGU Monograph No. 16, p. 275-284.

68. Reade, H., 1965, Evaluation of Geothermal Prospects in the Honey Lake Basin, Lassen County, California. In Preliminary Geothermal Investigation of Selected Areas in California. Unpublished report, Richfield Oil Corp., Exploration Department.

69. Reed, Marshall J., Chemistry of Thermal Water in Selected Geothermal Areas of California, California Division of Oil and Gas, Report No. TR15, 1975.

70. Renner, J.L., D.E. White, and P.L. Williams, 1975, Hydrothermal Convection Systems. In Assessment of Geothermal Resources of the United States. USGS Circ. 726, p. 5-57.

71. Riddell, F.A., 1957, Final Report on the Archaeology of Tommy Tucker Cave. University of California Archaeological Survey, Report 35:1-25. Berkeley, California.

72. Riddell, F.A., 1960, The Archaeology of the Karlo Site (Las-7), California. University of California Archaeological Survey, Report 53. Berkeley, California.

73. Robbins, Birds of North America, Golden Press, New York, 1966.

74. Schurch, J.P., Data of Geochemistry, Chapter 5. In Chemical Composition of Subsurface Waters by D.E. White, J.D. Hem, and G.A. Waring. USGS Prof. Paper 440-F, p. F50-F51, 1963.

75. Stewart, O.C., 1966, Tribal Distributions and Boundaries in the Great Basin. In The Current Status of Anthropological Research in The Great Basin, 1964 Ed. by d'Azevedo, et.al. Desert Research Institute, Reno, Nevada.

76. Stibbans, Amphibians and Reptiles of Western North America, McGraw and Hill Book Company, 1954.

77. Stibbans, A Field Guide to Western Reptiles and Amphibians, Houghton Mifflin Co. Boston.

78. Tadlock, W.L., 1966, Certain Crescentic Stone Objects as a Time Marker in the Western United States. American Antiquity 31:662-675.

79. Tunell, G., 1970, Mercury -- Behavior in Magmatogenic Processes. In Handbook of Geochemistry. Springer-Verlag, Berlin, Heidelberg, N.Y., 1974, pp. 8--F-1-80-F-21, v. II/4.

80. University of California Agricultural Extension and Lassen County, Selected Economic Data, Lassen County, California.

81. U.S. Bureau of the Census, U.S. Census of Population 1970, Washington, D.C.

82. USDA, Soil Conservation Service, General Soil Map, Lassen County, California, 1967.

83. USDA, Soil Conservation Service, Water and Related Land Resources, Central Lahontan Basin, Calvada Subdivision, Appendix 1, July 1973.

84. U.S. Department of the Interior, Bureau of Land Management. District SLUP and RUP files, 1970-1976. Susanville, California, Bureau of Land Management.

85. U.S. Department of the Interior, Bureau of Land Management. Management Framework Plan, Cal-Neva Planning Unit. Susanville, California, Bureau of Land Management.

86. U.S. Department of the Interior, Bureau of Land Management. Management Framework Plan, Honey Lake Planning Unit. Susanville, California, Bureau of Land Management.

87. U.S. Department of the Interior, Bureau of Land Management. Susanville District Office, Project files, No. 1062, 0409, 4078.

88. U.S. Department of the Interior, Bureau of Land Management. Visual Resource Management Manual, 6300.

89. U.S. Department of the Interior, Final Environmental Statement for the Geothermal Leasing Program, Washington, D.C., 1973.

90. U.S. Department of the Interior, U.S. Department of Agriculture, 1970. Environmental Criteria for Electric Transmission Systems.

91. U.S. Geological Survey, Geothermal Resource Operational Orders No. 1-4, January 1976.

92. U.S. Geological Survey, Office of Geothermal Supervisor, Input to Wendel-Amedee EAR, Honey Lake Valley, California, August 1976.

93. Van Wormer, D. Personal communication, Seismologist, University of Nevada, Reno, 1976.

94. Ward, P.L., 1972, Microearthquakes: Prospecting Tool and Possible Hazard in the Development of Geothermal Resources. Geothermics, v. 1, No. 1, p. 3-12.

95. White, D.E. and Williams, D.L. ed., Assessment of Geothermal Resources of the United States 1975, U.S. Geological Survey Circ. 726, 1975.

XIII. APPENDICES

APPENDIX 1

DEFINITION OF KNOWN GEOTHERMAL RESOURCE AREA

The following has been taken from published regulations on the leasing of Geothermal Resources, 43 CFR 3200.0-5, Definitions.

Known geothermal resource area (KGRA) means an area in which the geology, nearby discoveries, competitive interests, or other indicia would, in the opinion of the Secretary of the Interior, engender a belief in men who are experienced in the subject matter that the prospects for extraction of geothermal steam or associated geothermal resources are good enough to warrant expenditures of money for that purpose.

1. In determining whether the geology of an area is of such a nature that the area should be designated a KGRA the Director, Geological Survey, acting for the Secretary, shall use such geologic and technical evidence as he shall deem appropriate, including the following:

(i) The existence of siliceous sinter and natural geysers;

(ii) The temperatures of fumaroles, thermal springs, and mud volcanoes;

(iii) The SiO_2 content of spring water;

(iv) The Na/K ratio in spring waters of hot-water systems;

(v) The existence of volcanoes and calderas of late Tertiary or Quaternary age;

(vi) Conductive heat flows and geothermal gradient;

(vii) The porosity and the permeability of a potential reservoir;

(viii) The results of electrical resistivity surveys;

(ix) The results of magnetic, gravity, and airborne infrared geophysical surveys; and

(x) The information obtained through other geophysical methods such as microseismic, seismic ground noise, electromagnetic, and tulluric surveys if such methods prove to have significant use in evaluation.

2. For purposes of KGRA classification, a "discovery" or "discoveries" will be considered to be any well deemed by the Director, Geological Survey, to be capable of producing geothermal resources in

commercial quantities and, where the geological structure is not known, "nearby" will be considered to be five miles or less from any such discovery. Lands nearby a discovery will be classified as KGRA unless the Geological Survey determines that the lands are on a different geologic structure from the discovery. Where the Geological Survey has determined the extent of a structure on which a discovery has been made, all land in that structural area contributing geothermal resources to that discovery will be deemed a KGRA regardless of the distance from the discovery.

APPENDIX 2

LEGAL DESCRIPTIONS OF POTENTIAL LEASING UNITS

Potential Leasing Unit	
1. NC-CA-1266	T.29N., R.15E., MDM Sec. 10, NW¼, N½NE¼, N½SW¼ *Sec. 11, N½N½ Sec. 12, NE¼, N½NW¼. SE¼NW¼, NE¼SE¼, S½SE¼, SE¼SW¼ Total: 920 Ac. Remaining: 760 Ac.
2. NC-CA-1259	T.29N., R.16E., MDM Sec. 21, All *Sec. 27, W½ Sec. 28, N½, SW¼SW¼, E½SE¼, SW¼SE¼ *Sec. 34, W½ Total: 1760 Ac. Remaining: 1120 Ac.
3. NC-CA-1261	T.28N., R.16E., MDM +Sec. 3, All *Sec. 10, S½, NW¼ *Sec. 11, SW¼, E½SE¼ Total: 1360 Ac. Remaining: 0 Ac.
4. Private with minerals reserved to United States	**T.29N., R.15E., MDM Sec. 22, S½NE¼, NE¼SW¼, N½SE¼ Sec. 23, W½NW¼ Total: 320 Ac.
5. NRL in KGRA	T.29N., R.15E., MDM Sec. 13, E½NE¼, NW¼NE¼, NW¼, NE¼SW¼ Sec. 24, NE¼ T.29N., R.16E., MDM Sec. 18, Lots 1-4, NE¼, E½NW¼, E½SW¼, SE¼. (All) Sec. 19, Lot 1, NE¼NW¼ Total: 1205

APPENDIX 2 (Continued)

LEGAL DESCRIPTIONS OF POTENTIAL LEASING UNITS

<u>Potential Leasing Unit</u>	
6. NRL in KGRA	T.29N., R.16E., MDM Sec. 20, E½, E½NW¼, NE¼SW¼ Sec. 29, E½ Sec. 30, Lots 3, 4, E½NW¼, NE¼SW¼ Sec. 31, Lot 1, N½NE¼, NE¼NW¼ Sec. 32, E½NW¼, SW¼NW¼, N½SW¼ Total: 1322 Ac.
7. NRL in KGRA	T.28N., R.16E., MDM Sec. 4, Lots 1, 2, 3, S½NE¼, SE¼ Sec. 8, SENE, NESE Unsurveyed land lying between Townships 28 and 29N., Ranges 15 and 16E.; directly north of Sections 4, 5 and 6, T.28N., R.16E.; totaling approximately 440 acres. T.29N., R.16E., MDM Sec. 32, NE¼ Sec. 33, E½, NW¼, E½SW¼ Total: 1600 Ac.
8. NC-CA-1052	T.27N., R.15E., MDM Sec. 3, Lots 2-4, SE¼NW¼ Sec. 4, Lots 1-4, N½SW¼, SE¼NW¼, NE¼SE¼ Sec. 9, E½ Sec. 15, NW¼ T.28N., R.15E., MDM Sec. 33, Lots 1-5 Sec. 32, Lot 1 Sec. 34, Lots 1-3 Sec. 35, Lot 1 Total: 1171 Ac.

LEGAL DESCRIPTIONS OF POTENTIAL LEASING UNITS

Potential Leasing Unit	
9. NC-CA-1051	T.27N., R.15E., MDM Sec. 13, S½, S½N½ Sec. 14, S½SE¼ Sec. 23, Lots 1, 2, N½ N½SE¼ *Sec. 25, Lots 1, 3 Sec. 27, Lot 6 Total: 1056 Ac.
10. Private with minerals reserved to United States NRL	**T.27N., R.15E., MDM Sec. 24, E½NE¼, NW¼NE¼, E½SE¼, SW¼SE¼ *Sec. 25, Lots 1, 3 T.27N., R.16E., MDM Sec. 19, Lots 1-4, NE¼, E½NW¼, E½SW¼ Sec. 29, SW¼NW¼ Total: 931 Ac.
11. NC-CA-1027	T.27N., R.16E., MDM Sec. 8, Lot 7 Sec. 17, S½ ++Sec. 18, Lots 1-4, E½, E½W½ (All) Sec. 20, NW¼, NW¼SW¼, SE¼, W½NE¼ Total: 1439 Ac. Remaining: 803 Ac.

* Didn't apply for all NRL per 43 CFR 3210.2-1(c).

** Land patented under Stock-Raising Homestead Act of 1916 with all minerals reserved to United States.

\+ Withdrawn per letter dated 11-8-76 from Gulf Oil Corporation.

++ Withdrawn by War Department PL065.

APPENDIX 3

POTENTIAL GEOTHERMAL LEASES ON PRIVATE LANDS WITHIN OR ADJACENT TO THE STUDY AREA

	Lessee	Lessor	Lassen County Records Book/Page
1.	Gulf Oil Corp.	Jack W. Humphrey, Margaret Humphrey	249/459
2.	Gulf Oil Corp.	Robert K. Cisko	249/462
3.	Gulf Oil Corp.	Mapes Ranch Inc.	250/218
4.	Gulf Oil Corp.	Lauretta Helman	255/503
5.	Gulf Oil Corp.	Florence E. Brandon	255/505
6.	Gulf Oil Corp.	George M. Long, Lena Sue Long	255/507
7.	Gulf Oil Corp.	Clarence M. Jones Donna K. Jones	255/509
8.	Gulf Oil Corp.	A & K Company	255/572
9.	Gulf Oil Corp.	F. O. Dannelley, Mildred Dannelley	257/198
10.	Gulf Oil Corp.	Howard Hammitt, Jr.	257/200
11.	Gulf Oil Corp.	W. E. Buell, Rebecca I. Buell	257/209
12.	Gulf Oil Corp.	Casino Land & Livestock Company	258/544
13.	Gulf Oil Corp.	James E. Pardee, Donna W. Pardee	260/449
14.	Gulf Oil Corp.	Dean T. Sanders, Georgia Sanders	260/451
15.	Gulf Oil Corp.	Sacramento Ranchos, Inc.	261/86
16.	Gulf Oil Corp.	Catherine Ithurburn	261/682

	Lessee	Lessor	Lassen County Records Book/Page
17.	Gulf Oil Corp.	Harry S. Hooper, Ceta L. Hooper, Warren A. Tinsley	261/684
18.	Gulf Oil Corp.	William T. Hail, A. Blanche Hail	268/570
19.	Wayne E. Owen, Sandra M. Owen	Ray E. Jones	289/468
20.	Geo Products Corp.	Frank J. Mistretta, Margaret O. Mistretta	302/435
21.	Geo Products Corp.	Alexander Black VTN Consolidated, Inc.	308/620
22.	Geo Mac, Inc. (50%) McCulloch Oil Corp. (50%)	Joyce M. Wells K.C. Wells, Jr.	313/263
23.	Geo Mac, Inc. (50%) McCulloch Oil Corp. (50%)	John C. Tranchina Doris E. Tranchina	313/263
24.	Geo Mac, Inc. (50%) McCulloch Oil Corp. (50%)	Patrick C. Walsh Darlene F. Walsh Estate of Franklin DeWitt Bonnie DeWitt	313/263
25.	Geo Mac, In.c (50%) McCulloch Oil Corp. (50%)	John H. Theodore Deesee Theodore	313/263
26.	Geo Mac, Inc. (50%) McCulloch Oil Corp. (50%)	Dean Beckett Donna Beckett	313/263
27.	Geo Mac, Inc. (50%) McCulloch Oil Corp. (50%)	Stanley Pleatman Ann Pleatman	313/263
28.	Geo Mac, Inc. (50%) McCulloch Oil Corp. (50%)	Chester Ashford Ruby Terry Ashford	313/263
29.	Geo Mac, Inc. (50%) McCulloch Oil Corp. (50%)	Honey Lake Ranch	313/263

APPENDIX 4

SOIL CHARACTERISTICS AND QUALITIES

Map unit symbol (1)	Constituent soils or land types in map unit (2)	Physiography (3)	Typical vegetation (4)	Drainage (5)	Estimated coarse fragments: Surface density (%) (6)	Estimated coarse fragments: Subsoil (% by volume) (7)	Profile permeability (8)	Depth to hardpan or bedrock (9)	Reaction (10)
(419) (1402 Ac.)	Durixerollic Calciorthids sandy, mixed, mesic, 0 to 5 percent slopes. (25%)	Basin shoreline	Saltgrass	Well	None	None	Rapid	60 inches	Moderately alkaline
	Typic Calciorthids, sandy-skeletal, mixed, mesic, 0 to 15 percent slopes, stony. (25%)	Terrace	Desert shrub	Well	5 to 15 stones, cobbles	35 to 65 cobbles, stones	Rapid	60 inches	Moderately alkaline
	Durixerollic Haplargids, fine-loamy, mixed, mesic 5 to 15 percent slopes. (20%)	Alluvial fans and terraces	Big sage-brush	Well	10 gravel	10 gravel, cobbles	Moderate	60 inches	Strongly alkaline
	Typic Torripsamments, mixed, mesic, 0 to 15 percent slopes, over-blown. (15%)	Dunes	Desert shrub	Well	None	None	Rapid	60 inches	Mildly alkaline
	Entic Ultic Haploxer-olls, sandy, mixed, mesic, 0 to 5 percent slopes. (10%)	Alluvial fans	Big sage-brush	Well	10 boulders, stones	About 10 gravel, cobbles	Rapid	60 inches	Slightly acid
	Inclusions of Argix-erolls. (5%)								

(Water & related Land Resources, Nevada Dept. Conservation & Dept. Agr. p. 63)

APPENDIX 4 (Continued)

SOIL CHARACTERISTICS AND QUALITIES

Map unit symbol (1)	Constituent soils or land types in map unit (2)	Physiography (3)	Typical vegetation (4)	Drainage (5)	Estimated coarse fragments: Surface density (%) (6)	Estimated coarse fragments: Subsoil (% by volume) (7)	Profile permeability (8)	Depth to hardpan or bedrock (9)	Reaction (10)
(420) (80 Ac.)	Xerollic Natrargids, fine, montmorillonitic, mesic, 0 to 5 percent slopes. (30%)	Basin	Desert shrub	Well	None	None	Slow	> 60 inches	Mildly alkaline
	Typic Calciorthids, fine-loamy over sandy or sandy-skeletal, mixed, mesic, 0 to 5 percent slopes. (25%)	Lake terraces	Shadscale, bud sagebrush	Well	None	None	Moderate	> 60 inches	Strongly alkaline
	Dureixerollic Haplargids, fine-loamy, mixed, mesic, 0 to 5 percent slopes. (20%)	Alluvial fans	Desert shrub	Well	None	None	Moderate	> 60 inches	Mildly alkaline
	Typic Durargids, loamy, mixed, mesic, 0 to 5 percent slopes, shallow. (15%)	Basin	Shadscale, spiny hopsage, budsage, greasewood	Well	None	None	Moderate	About 10 inches to hardpan	Mildly alkaline
	Inclusions of Playas and dunes. (10%)								

APPENDIX 4 (Continued)

SOIL CHARACTERISTICS AND QUALITIES

Map unit symbol (1)	Constituent soils or land types in map unit (2)	Physiography (3)	Typical vegetation (4)	Drainage (5)	Estimated coarse fragments: Surface density (%) (6)	Estimated coarse fragments: Subsoil (% by volume) (7)	Profile permeability (8)	Depth to hardpan or bedrock (9)	Reaction (10)
(423) (1150 Ac.)	Xerollic Natrargids, fine, montmorillonitic, mesic, 0 to 5 percent slopes. (65%)	Basin	Desert shrub	Well	None	None	Slow	>60 inches	Mildly alkaline
	Xerollic Haplargids, fine-loamy, mixed, mesic, 0 to 5 percent slopes. (20%)	Old smooth terraces	Big & low sagebrush	Well	<20 fine gravel	About 30 gravel	Moderate	>60 inches	Strongly alkaline
	Aquic Durorthidic Xerofluvents, fine-silty, mixed, nonacid, mesic, 0 to 5 percent slopes, saline-alkali. (10%)	Basin	Greasewood, saltgrass, rabbitbrush	Somewhat Poor	None	None	Moderate	>60 inches	Very strongly alkaline
	Inclusions of Aquolls. (5%)								

APPENDIX 4 (Continued)

SOIL CHARACTERISTICS AND QUALITIES

Map unit symbol (1)	Constituent soils or land types in map unit (2)	Physiography (3)	Typical vegetation (4)	Drainage (5)	Estimated coarse fragments: Surface density (%) (6)	Estimated coarse fragments: Subsoil (% by volume) (7)	Profile permeability (8)	Depth to hardpan or bedrock (9)	Reaction (10)
(424) (10 Ac.)	Xerollic Natrargids, fine, montmorillonitic, mesic, 0 to 5 percent slopes. (35%)	Basin	Desert shrub	Well	None	None	Slow	> 60 inches	Mildly alkaline
	Xerollic Haplargids, fine-loamy, mixed, mesic, 0 to 5 percent slopes. (25%)	Old smooth terraces	Big & low sagebrush	Well	< 20 fine gravel	About 30 gravel	Moderate	> 60 inches	Strongly alkaline
	Fluventic Haplaquolls, fine, montmorillonitic (calcareous), mesic, 0 to 5 percent slopes. (15%)	Basin	Meadow	Poor	None	None	Slow	> 60 inches	Strongly alkaline
	Vertic Haplaquolls, fine, montmorillonitic (calcareous), mesic, 0 to 5 percent slopes. (15%)	Basin	Meadow	Poor	None	None	Slow	> 60 inches	Strongly alkaline
	Inclusions of Xerolls, and saline areas. (10%)								

APPENDIX 4 (Continued)

SOIL CHARACTERISTICS AND QUALITIES

Map unit symbol (1)	Constituent soils or land types in map unit (2)	Physiography (3)	Typical vegetation (4)	Drainage (5)	Estimated coarse fragments: Surface density (%) (6)	Estimated coarse fragments: Subsoil (% by volume) (7)	Profile permeability (8)	Depth to hardpan or bedrock (9)	Reaction (10)
(425) (400 Ac.)	Durixerollic Haplargids, coarse-loamy, mixed, mesic, 0 to 5 percent slopes. (30%)	Basins	Big sagebrush	Well	None	None	Moderately rapid	>60 inches	Mildly alkaline
	Durixerollic Natrargids, coarse-loamy, mixed, mesic, 0 to 5 percent slopes. (25%)	Basins	Greasewood, big sagebrush	Well	None	None	Moderate	>60 inches	Strongly alkaline
	Typic Xerorthents, coarse-loamy, mixed, nonacid, mesic, 0 to 5 percent slopes. (25%)	Flood plains	Cropland	Well	None	None	Moderate	>60 inches	Neutral
	Typic Xeropsamments, mixed, mesic, 0 to 5 percent slopes. (15%)	Alluvial fans & flood channels	Big sagebrush, bitterbrush, spiny hopsage	Well	None	None	Rapid	>60 inches	Neutral
	Inclusions of Playas and dunes. (5%)								

APPENDIX 4 (Continued)

SOIL CHARACTERISTICS AND QUALITIES

Map unit symbol (1)	Constituent soils or land types in map unit (2)	Physiography (3)	Typical vegetation (4)	Drainage (5)	Estimated coarse fragments: Surface density (%) (6)	Estimated coarse fragments: Subsoil (% by volume) (7)	Profile permeability (8)	Depth to hardpan or bedrock (9)	Reaction (10)
(426) (3,644 Ac.)	Xerollic Natrargids, fine-loamy, mixed, mesic, 0 to 5 percent slopes. (55%)	Basin	Greasewood, shadscale	Well	None	None	Moderate	> 60 inches	Strongly calcareous
	Typic Calciorthids, fine-loamy, over sandy or sandy-sketetal, mixed, mesic, 0 to 5 percent slopes. (30%)	Lake Terraces	Shadscale, budsage	Well	None	None	Moderate	>60 inches	Strongly alkaline
	Inclusions of Playas and dunes. (15%)								

APPENDIX 4 (Continued)

SOIL CHARACTERISTICS AND QUALITIES

Map unit symbol (1)	Constituent soils or land types in map unit (2)	Physiography (3)	Typical vegetation (4)	Drainage (5)	Estimated coarse fragments: Surface density (%) (6)	Estimated coarse fragments: Subsoil (% by volume) (7)	Profile permeability (8)	Depth to hardpan or bedrock (9)	Reaction (10)
(4063) (3606 Ac.)	Xerollic Haplargids, fine, montmorillonitic, mesic, 30 to 50 percent slopes, very stony. (50%)	Mountain slopes	Big sagebrush	Well	50 to 70 cobbles, stones	15 to 20 gravel	Slow	About 30 inches to hard volcanic bedrock	Neutral
	Lithic Xerollic Haplargids, loamy, mixed, mesic, 50 to 70 percent slopes, very stony. (30%)	Mountain slopes	Big sagebrush	Well	50 to 70 cobbles, stones	15 to 20 gravel	Moderate	About 18 inches to hard volcanic bedrock	Neutral
	Durixerollic Haplargids, fine, montmorillonitic mesic, 15 to 30 percent slopes, very stony. (15%)	Mountain slopes	Big sagebrush	Well	30 cobbles, stones	20 gravel	Slow	About 40 inches to hard volcanic bedrock	Neutral
	Inclusions of Rock outcrop and Orthents. (5%)								

cAPPENDIX 4 (Continued)

SOIL CHARACTERISTICS AND QUALITIES

Map unit symbol (1)	Constituent soils or land types in map unit (2)	Physiography (3)	Typical vegetation (4)	Drainage (5)	Estimated coarse fragments: Surface density (%) (6)	Estimated coarse fragments: Subsoil (% by volume) (7)	Profile permeability (8)	Depth to hardpan or bedrock (9)	Reaction (10)
(4064) (280 Ac.)	Xerollic Haplargids, fine, montmorillonitic, frigid, 30 to 50 percent slopes, very stony. (45%)	Mountain slopes	Juniper, big sagebrush	Well	50 stones, cobbles	30 gravel, cobbles, stones	Slow	About 36 inches to hard volcanic bedrock	Neutral
	Lithic Xerollic Haplargids, loamy-skeletal, mixed, frigid, 50 to 70 percent slopes, extremely stony. (35%)	Mountain slopes	Juniper, big sagebrush	Well	50 to 70 stones, cobbles	35 to 50 gravel	Moderate	About 16 inches to bedrock	Neutral
	Inclusions of Rubble land, Rock outcrop and Orthents. (20%)								

APPENDIX 5

CONCEPTS AND STUDY METHODOLOGY FOR AESTHETIC EVALUATION

Scenic Quality

The Bureau of Land Management's Recreation Information System methodology for rating scenic quality was used for this portion of the aesthetic evaluation (Table A-1).

Four landscape features (landform, water, vegetation and man-introduced intrusions) and the overall aspects of color and uniqueness are evaluated. The uniqueness factor provides an opportunity to give added importance to one or all of the scenic factors. The condition of each individual factor determines its numerical score, with the sum of the individual scores determining the scenery class as indicated at the bottom of the chart.

Visual Sensitivity

Five key criteria of visual sensitivity were utilized for this study. These include: (1) highway and road-use volume; (2) recreation-use volume (trails, water bodies, facilities, etc.); (3) general social attitudes toward notable intrinsic resources (potential primitive, natural and cultural areas); (4) community land uses, relationship, attitudes, etc., considering all private uses of the land; and (5) relationships and plans of other governmental agencies.

As indicated on Table A-2, a range of three possible conditions exists for each criterion. The most sensitive condition of each is found in the left column and the least sensitive in the right column. The factors are not necessarily of equal importance in determining visual sensitivity and must initially be ranked in relative importance. If a criterion is not present in a particular area, it is left entirely out of consideration.

The condition of each criterion is then mapped. Based on the sensitivity level of each criterion present and the criterion weight, the visual sensitivity of the area is determined.

Visual Prominence Zones

Visual zones are areas where an intrusion would be visible with zones categorized as foreground-middleground, background or seldom seen.

This step must be completed in the field by travelling each route, observing the area that can be viewed, then delineating the zones on a map. Highways and roads should be driven in both directions.

APPENDIX 5 (Continued)

Table A-1

SCENERY QUALITY INVENTORY CHART

KEY FACTORS	RATING CRITERIA AND SCORE		
LAND FORM	Vertical or near vertical cliffs, spires, highly eroded formations, massive rock out-crops, severe surface variation. 4	Steep canyon walls mesas, interesting erosional patterns, variety in size and shape of land forms. 2	Rolling hills, foot-hills, flat valley bottoms. 1
COLOR	Rich color combinations, variety or vivid contrasts in the color of soil, rocks, vegetation of water. 4	Some variety in colors and contrast of the soil, rocks and vegetation, but not dominant. 2	Subtle color variations, little contrast, generally muted tones. Nothing really eye-catching. 1
WATER	Still, chance for reflections or cascading white water, a dominant factor in the landscape. 4	Moving and in view or still but not dominant. 2	Absent, or present but seldom seen. 1
VEGETATION	A harmonius variation in form, texture, pattern and type. 4	Some variation in pattern and texture, but only one or two major types. 2	Little or no variation, contrast lacking. 1
UNIQUENESS	One of a kind or very rare within region. 6	Unusual but similar to others within the region. 2	Interesting in its setting, but fairly common within the region. 1
INTRUSIONS	Free from aesthetically undersiror discordant sights and influences. 2	Scenic quality is somewhat depreciated by inharmonious intrusions but not so extensive that the scenic qualities are entirely negated. 1	Intrusions are so extensive that scenic qualities are for the most part nullified. -4

Explaination of Key Factors:

Land Form or topograpy becomes more interesting as it sets steeper and more massive.

Table A-1 (Continued)

Color. The overall color of the basic components of the landscape (soil, rocks, vegetation, etc.) are considered as they appear during the high use season. Key factors in rating "color are variety, contrast and harmony.

Water is the ingredient that adds movement or serenity to a scene. The degree to which water dominates the scene is the primary consideration in selecting the rating score.

Vegetation. Primary consideration is given to the variety of patterns, forms, and texture created by the vegetation.

Uniqueness. This factor provides an opportunity to give added importance to one or all of the scenic features if they are relatively unique within any one physiographic region. There may also be cases where a separate evaluation of each of the key factors does not give a true picture of the overall scenic quality of an area. Often a number of not so spectacular elements in the proper combination produces the most pleasing scenery--the uniqueness factor can be used to recognize this type of area and give it added emphasis.

Intrusions The impact of man-made features on the aesthetic quality is considered. These intrusions can have a positive or negative aesthetic impact.

Scenery A = 15-24; Scenery B = 10-14; Scenery C = 1-9

APPENDIX 5 (Continued)

Table A-2

VISUAL SENSITIVITY SYSTEM

SENSITIVITY CRITERIA	CRITERIA CONDITION		
Highway and road use volume	+200 vehicles per day ADT year round or seasonal. 1/	20 to 200 vehicles per day ADT or seasonal. 1/	Less than 20 vehciles Oer day ADT or seasonal. 1/
Recreation use volume (trails, water bodies, facilities, etc.)	20,000 or more visits/ year.	2,000 to 20,000 visits/year.	Less than 2,000 visits/ year.
General social attitudes toward notable intrinsic resources (potential primitive, natural and cultural areas).	An area of much concern.	An area of moderate concern.	An area of little concern.
Community land uses, relationships, attitudes, etc. Consider all private uses of land: grazing, mining, utility companies, etc.	Scenic quality is very important.	Scenic quality is moderately important.	Scenic quality is not very important.
Relationships of other government agencies - Military, Fish & Game, Co. Gov't. etc.	Scenic quality is very important.	Scenic quality is moderately important.	Scenic quality is not very important.

1/ ADT = Average Daily Travel.

The foreground-middleground is the area visible from a travel route or use area to a distance of 3 to 5 miles. The outer boundary of this zone is defined as the point where the texture and form of individual plants are no longer apparent in the landscape. Vegetation is apparent only in patterns or outline.

Background is the area which lies beyond the foreground-middleground, usually from a minimum of 3 to 5 miles to a maximum of about 15 miles from a travel route or area. Atmospheric conditions in some areas may limit the maximum to about 8 miles or increase it beyond 15 miles.

Seldom seen zones are those that are seen from low-use volume transportation routes or are beyond the 15 to 20 mile background zone for other routes.

Visual Resource Management Classes

Once the results of the inventory of the existing environment have been compiled and mapped, the Visual Resource Management (VRM) classes are determined by overlaying the visual prominence, visual sensitivity, and scenic quality maps and delineating all areas with different combinations of values for these three factors. The values for each of the factors are located on a three-way matrix (Table A-3) which indicates the VRM objective class for each area. This procedure is repeated until all areas on the composite map have been assigned their respective VRM classes. All adjoining areas of the same class are combined and an overall VRM objective map results. The VRM classes are used as a basis for determining allowable impacts.

Below are listed the VRM classes as described in BLM Manual 6310.18 (U.S. Department of Interior, 1975d). They are used as tentative minimum management objectives. Each visual quality objective class describes a different degree of modification allowed in the basic elements of the landscape (line, form, color, and texture). The primary character of the landscape will be retained regardless of the degree of modification.

Class I. This class provides primarily for natural ecological changes only. It is applied to designated primitive areas, some natural areas, and other similar situations where management activities are to be restricted.

Class II. Changes in any of the basic elements (form, line, color or texture) caused by a management activity should not be evident in the characteristic landscape.

APPENDIX 5 (Continued)

Table A-3

VISUAL RESOURCE INVENTORY AND EVALUATION MATRIX

For

Determining Visual Resource Management Class

		VISUAL SENSITIVITY LEVEL 2/								
		HIGH			MEDIUM			LOW		
SPECIAL AREAS		I	I	I	I	I	I	I	I	I
	A	II	II	II	II	II	II	II	II	II
SCENERY	B	II	III	IV	III	III	IV	III	IV	IV
CLASS 1/	C	III	IV	IV	IV	IV	IV	IV	IV	IV
		F	B	S	F	B	S	F	B	S
		VISUAL PROMINENCE ZONES 3/								

1/ SCENERY QUALITY INVENTORY A,B,C

2/ VISUAL SENSITIVITY LEVEL High
Medium
Low

3/ VISUAL PROMINENCE ZONES F = Foreground-Middleground
B = Background
S = Seldom Seen

Note: Class I applies only to classified special areas, e.g., Primitive Natural Areas, etc. This quality standard is established through legislation or policy.

Class V applies to areas identified in the scenery quality inventory where the quality class has been reduced because of unacceptable intrusions.

Class I and Class V do not occur in the EAR area.

Class III. Changes in the basic elements (form, line, color and texture) caused by a management activity may be evident in the characteristic landscape. However, the changes should remain subordinate to the visual strength of the existing character.

Class IV. Changes may subordinate the original composition and character but will reflect some basic elements of the character type.

Class V. Change is needed. This class applies to areas where the natural character has been disturbed to a point where rehabilitation is needed to bring it back into character with the surrounding countryside. This class would apply to areas identified in the scenery evaluation where the quality class has been reduced because of unacceptable intrusions. It should be considered an interim short-term classification until one of the other objectives can be reached through rehabilitation or enhancement. The desired visual quality objective should be identified.

APPENDIX 6

TRANSPORTATION AND DISPOSAL OF WASTE

Division 7.5 of the California Water Code and Subchapter 13 of Chapter 3, Title 23, California Administrative Code, provide regulations for the transportation and disposal of liquid wastes. Subchapter 15 of Chapter 3, Title 23, California Administrative Code, further provides regulations for waste disposal to land. The following is a discussion of these regulations.

Definitions: "liquid waste" includes any solid or gaseous substances contained in such waste but does not include sewage, fertilizer, or any radioactive material that is subject to the Health and Safety Code.

"disposal site" means any place used for the disposal of solid or liquid wastes but does not include any part of a sewage treatment plant or point of discharge of sewage effluent or land drainage from pipes or ditches into waters of the State.

Disposal sites are divided into four classifications. Class 1 sites are those at which complete protection is provided for all time for the quality of ground and surface waters from all wastes deposited therein and against hazard to public health and wildlife resource.

Class 11-1 sites are those overlying usable ground water and geologic conditions are either naturally capable of preventing lateral and vertical hydraulic continuity between liquids and gases emanating from the waste in the site and usable surface of ground waters, or the disposal area has been modified to achieve such capability.

Class 11-2 sites are those having vertical and lateral hydraulic continuity with usable ground water, but for which geologic and hydraulic features such as soil type, artificial barriers, depth to ground water, and other factors will assure protection of the quality of usable ground water underneath or adjacent to the site.

Class 111 sites are those at which protection is provided to water quality from only nonwater soluble, nondecomposable inert solids by location, construction, and operation which prevent erosion of deposited material.

Wastes discharge to "disposal sites" are divided into three groups. Group 1 wastes consist of or contain toxic substances and substances which could significantly impair the quality of usable waters. Group 2 wastes consist of or contain chemically or biologically decomposable

material which does not include toxic substances nor those capable of significantly impairing the quality of usable waters. Group 3 wastes consist entirely of nonwater soluble, nondecomposable inert solids.

Group 1 wastes must be discharged only at Class 1 sites or Class 11-1 sites which have been approved by the executive officer of the Regional Board for disposal of specific Group 1 wastes. Group 2 wastes may be deposited only at Class 1, Class 11-1, or Class 11-2 sites. Group 3 wastes may be discharged at any classified site.

Most liquid wastes which are hauled to a disposal site are easily identified as Group 1, 2, or 3 wastes. A notable exception is waste drilling fluids which have been used in the drilling of oil, gas, geothermal, and water wells. Such wastes may either be Group 1 or Group 3 depending on the nature of materials added during or before use in the drilling process. There are literally hundreds of additives used in drilling fluids. Some of these contain toxic substances or those capable of significantly impairing the quality of usable waters. Most, however, do not contain such substances in sufficient concentrations to justify classification of the waste drilling fluid as a Group 1 waste.

To assure that all liquid wastes from drilling production of oil, gas, or geothermal wells, transported to off-site locations for disposal are hauled to approved sites, the following guideline will apply;

> The Area Geothermal Supervisor will ascertain the character of all wastes to be hauled to off-site locations for disposal and advise the driller, producer, or hauler regarding the nearest approved disposal sites for such waste and will notify the Regional Board of any Group 1 or 2 wastes to be hauled to a surface disposal site.

APPENDIX 7

WATER DISCHARGE MONITORING AND REPORTING PROGRAM

Notification

The discharger shall submit a notice in writing to the Leasing Officer at least 30 days prior to any construction associated with well drilling or drill site preparation, including road construction. The notice shall include:

1. Proposed construction dates
2. Location of the facilities
3. Description of the facilities
4. Method of construction
5. Proposed location of ultimate disposal of drilling muds
6. Construction details of mud disposal sump

The discharger shall notify the Leasing Officer, in writing, no later than five (5) days after the following events:

1. First waste discharge to the waste sump
2. Completion of the well or wells scheduled to be drilled adjacent to the waste sump
3. Completion of all waste discharges to the waste sump
4. Completion of the final sump closing activities

In addition, the discharger shall immediately notify the Leasing Officer of any circulation loss during the construction of a well. The notice shall include:

1. Location of the well
2. Depth of the well
3. Amount of drilling mud lost
4. Method of correction

Monitoring

1. The discharger shall record the volume of waste material removed to an approved disposal sump each week and report that data to the Leasing Officer monthly.

2. Samples of condensate to be disposed of by injection shall be analyzed for the following constituents:

APPENDIX 7 (Continued)

Constituents	Units	Type of Sample	Sampling and Reporting Frequency
Electrical Conductivity	micromhos	grab	annually
Boron	mg/l	grab	annually
Sulfate	mg/l	grab	annually
Nitrate	mg/l	grab	annually
Volume	bbls/mo.	--	monthly

Reporting

In reporting the monitoring data, the discharger shall arrange the data in tabular form so that the date, the constituents, and the concentrations are readily discernible. The monitoring and any necessary narrative reports shall be transmitted to the Leasing Officer within 15 days of data collection.

APPENDIX 8

PROPOSALS AND REGULATIONS FOR RAPTORS

In response to requests for input to the Honey Lake Geothermal EAR (see APPENDICES 9 and 10), a letter was received from the Field Supervisor, Fish and Wildlife Service, Sacramento, dated May 11, 1976. BLM was referred to USFWS Regional Director's memos of October 31, 1975 and April 15, 1976, in which general recommendations for the protection and documentation of fish and wildlife resources were included. Specific recommendations pertaining to waterfowl and nongame species, including raptors, etc. are as follows:

Waterfowl

a. No surface disturbance or intrusion related to geothermal development should be allowed within one-half mile of waterfowl nesting, brooding, and/or molting areas.

Nongame Species, Including Raptors, etc.

a. All endangered or threatened wildlife species should be provided the protection necessary for their survival, in compliance with the 1973 Endangered Species Act (Public Law 93-205, 87 Stat. 884).

b. In case there is discovered an aerie of any bird of prey that the Secetary of the Interior or the State Fish and Game management agency lists as "Endangered" or "Threatened," there should be established a "critical habitat zone" (CHZ) to ensure the protection of said aerie; such zone generally to consist of an area exempt from any and all surface activity within one-half mile of the aerie, and held inviolate to any intrusion except under special authorization by the land managing agency, with concurrence from the State Fish and Game agency and the U.S. Fish and Wildlife Service.

c. An additional one-half mile area around each aerie should be closed to entry from February 1 to September 1 each year except when authorized in writing by the land managing agency, with concurrence from the State Fish and Game managing agency and the U.S. Fish and Wildlife Service.

d. Powerlines, including towers, should be so designed and so arranged that their threat to raptors is minimized and their benefits to raptors are maximized.

All raptors are included in the list of Migratory Birds, published in the Federal Register, Wednesday, 8-15-73, V. 38, No. 157, Sec. 10-13, pp. 22017 et al. If a bird is included in this list it is protected by the Migratory Bird Treaties with the United States and Canada (August 16, 1916) and the United States and Mexico (February 7, 1936). These treaties provide protection that makes the taking, killing or possession of migratory birds unlawful unless and except as permitted by regulations.

MIGRATORY BIRD TREATY

16 U.S.C. § 703. Taking, killing, or possessing migratory birds unlawful.

Unless and except as permitted by regulations made as hereinafter provided in sections 703 to 711 of this title, it shall be unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, possess, offer for sale, sell, offer to barter, barter, offer to purchase, purchase, deliver for shipment, ship, export, import, cause to be shipped, exported, or imported, deliver for transportation, transport or cause to be transported, carry or cause to be carried, or receive for shipment, transportation, carriage, or export, any migratory bird, or any part, nest, or egg of any such birds, included in the terms of the conventions between the United States and Great Britain for the portection of migratory birds concluded August 16, 1916 (39 Stat. 1702), and the United States and the United Mexican States for the protection of migratory birds and game mammals concluded February 7, 1936. (July 3, 1918, ch. 128, § 2, 40 Stat. 755: June 20, 1936, ch. 634, § 3, 49 Stat. 1556.)

An even more stringent law, the Bald Eagle Protection Act (16 U.S.C. 668-668-c), has been passed and includes not only bald eagles but golden eagles. Pertinent sections from this Act are as follows:

BALD EAGLE PROTECTION ACT
16 U.S.C. 668-668c.

16 U.S.C. § 668. Bald and golden eagles.

(a) Prohibited acts; criminal penalties.

Whoever, within the United States or any place subject to the jurisdiction thereof, without being permitted to do so as provided in sections 668 to 668d of this title, shall knowingly, or with wanton disregard for the consequences of his act take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or in any manner any bald eagle commonly known as the American eagle or any golden eagle, alive or dead, or any part, nest, or egg thereof of the foregoing eagles, or

whoever violates any permit or regulation issued pursuant to sections 668 to 668d of this title, shall be fined not more than $5,000 or imprisoned not more than one year or both:

§ 668c. Same; definitions.

As used in sections 668 to 668d of this title "whoever" includes also associations, partnerships, and corporations; "take" includes also pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb; "transport" includes also ship, convey, carry, or transport by any means whatever, and deliver or receive or cause to be delivered or received for such shipment, conveyance, carriage, or transportation. (As amended Oct. 23, 1972, Pub. L. 92-535, § 4, 86 Stat. 1065).

The guidelines from U.S. Fish and Wildlife Service, the Migratory Bird Treaties, and the Bald Eagle Protection Act were the background for the proposed mitigation as put forth in Chapter IV, Wildlife, Waterfowl and Shore Birds, and Birds of Prey (Raptors).

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
District Office
P.O. Box 1090
Susanville, California
96130

IN REPLY REFER TO
1791(C-020)

April 16, 1976

APPENDIX 9

A public meeting will be held for the benefit of all parties interested in the environmental analysis concerning proposed geothermal leasing in the Honey Lake Valley project area. The meeting will be held Wednesday, April 28, 1976, 7:30 p.m. at the U.S. Forest Service Eagle Lake District Office, 1800 Main Street, Susanville, CA. If there is anyone in your organization who might assist us in our efforts by providing information or simply would like additional information on the project, we would like to encourage them to attend. Any information you might have which will increase the effectiveness of our environmental analysis would be appreciated.

If you wish to make a formal written report or statement, we would like notification by letter or phone at the above address by April 26th (phone 916 257-5385). However, the intent of this particular public meeting is to remain as informal as possible and provide as much time as possible toward a mutual exchange of information to be used in the development of the Environmental Analysis Record (EAR).

Sincerely,

for C. Rex Cleary
District Manager

CALIFORNIA
BLM
BUREAU OF LAND MANAGEMENT

FOR RELEASE Immediately - 4/20/76
CONTACT

News Release

UNITED STATES DEPARTMENT OF THE INTERIOR
Susanville District Office, P.O. Box 1090, Susanville, CA 96130

APPENDIX 10

Public Meeting - Honey Lake Valley Geothermal Leasing

Susanville Bureau of Land Management District Manager, Rex Cleary has announced that a public meeting will be held to encourage public involvement in the Environmental Analysis Record (EAR) for proposed geothermal leasing on lands administered by the Bureau of Land Management. The meeting will be held Wednesday, April 28, 1976, 7:30 p.m. at the U.S. Forest Service Eagle Lake District Office, 1800 Main Street, Susanville, CA. The area currently under study includes National Resource Lands in the Honey Lake Valley, Lassen County on which geothermal lease applications have been filed. This includes the Wendel-Amedee KGRA. No decisions concerning lease applications will be made prior to the completion of the geothermal environmental analysis.

Public input is being requested at this meeting regarding resources which may be affected by geothermal leasing. Included in the discussion will be a general orientation to the environmental analysis process and the relationship of proposed leasing with current BLM management policies. Principle speaker will be George Nielsen, Bureau of Land Management Geothermal Specialist from the Denver Service Center.

☆ US GOVERNMENT PRINTING OFFICE: 1974

This meeting will provide an opportunity for interested persons to become acquainted with the project area and discuss timeframes involved. A map of the study area is available upon request at the BLM Susanville District Office, 705 Hall Street, P.O. Box 1090, Susanville, California 96130.

XIV. GLOSSARY FOR WORDS AND PHRASES

Aboriginal - Pertaining to the original inhabitants of a geographic region.

Adaptive Strategy - In anthropology, the adaptations of a culture group to the exploitation of a set of subsistance resources which are presented by the local environmental panorama.

Aeolian - Applied to deposits arranged or deposited by the wind, as the sands and other loose materials along shores, etc., applied to the erosive action of the wind.

Alluvial Fan - A cone-shaped deposit of alluvium made by a stream where it runs onto a level plain or meets a slower stream.

Alluvium - A general term for all detrital deposits resulting from the operations of modern rivers, thus including the sediments laid down in river beds, flood plains, lakes, fans at the foot of mountain slopes, and estuaries; a term intended to apply to stream deposits of comparatively recent time.

Anabatic - Upward movement or flow of air.

Andesite/Basalt - Volcanic flow rocks, typically fine to medium grained, dark brown to black in color, composed essentially of iron, magnesium, aluminum calcium rich silicate minerals.

A Weighted (dB(A)) - The scale used on a sound-level meter to measure the relative noisiness or annoyance of sounds within the auditory sensitivity of the human ear.

Background - The area of a visual zone which lies beyond the foreground-middleground. Usually from a minimum of three to five miles to a maximum of about 15 miles from a travel route or use area. Atmospheric conditions in some areas may limit the maximum to about eight miles or increase it beyond 15 miles.

Biome - A complex community of all living organisms; i.e. tundra biome, grassland biome, desert biome.

Camping - An overnight stay in temporary quarters either inside or outside of a developed campground.

Color - The property of reflecting light of a particular wavelength that enables the eye to differentiate otherwise unidentifiable objects.

Core - In archaeology, a block of stone which has served for the production of flakes subsequently employed in artifact manufacture.

Decibel - A unit for measuring the relative loudness of sounds.

Decortication Flakes - Archaeological remnants, consisting of flakes of stone upon which the original natural surface (cortex) still adheres. they are indicative of the primary exploitation of raw stone resources.

Diurnal - In reference to ranges in temperature from day to night.

Ecotone - The zone of intergradation, whether narrow or wide, where two communities come into contact.

Enhancement - A short-term management alternative which is accomplished to increase the visual variety where little or no variety exists at present.

Ethnography - The descriptive study of the lifeways of a living group of people.

Foreground-Middleground - The area visible from a travel route or use area to a distance of three to five miles. The outer boundary of this zone is defined as the point where the texture and form of individual plants is no longer apparent in the landscape. Vegetation is apparent only in patterns or outline.

Form - The mass of an object or objects that appear unified.

Hiking - Travel by foot for exercise or recreation.

Holocene - Synonomous with recent geologic time, the most recent time division of geologic time.

Hunting - Lawful attempts to take game animals including species of big game, small game and waterfowl.

Intrusion - A feature (land, vegetation, or structure) which is generally considered out of context with the characteristic landscape.

Katabatic - Downward movement or flow of air.

Lacustrine - Produced by or belonging to lakes.

Leeward - Situated away from the wind, downwind.

Line - A point that has been extended. It may be anything that is arranged in a row or sequence.

Lithic - In archaeology, pertaining to stone or stone working technology.

Lithic Debitage - The detritus of aboriginal stone working technology.

Management Activity - An activity of man placed or undertaken on the landscape for the purpose of harvesting, traversing, transporting, protecting, changing, or replenishing natural resources.

Mesozoic - One of the great divisions or eras of geologic time, following the Paleozoic and succeeded by the Cenozoic era, comprising the Triassic, Jurassic and Cretaceous periods.

Midden - The characteristic soil which accumulates on archaeological sites which have been repeatedly occupied over long periods of time. It is affected principally by the introduction of massive organic components, and is chemically, visually, and tactilly distinguishable from surrounding culturally sterile soils.

Motorcycle Enduro - A competitive event designed to test the rider's skill and endurance. Usually the course is a minimum of 50 miles, over varying terrain, with several checkpoints placed at intervals along the course.

Normal Fault - A fault at which the hanging wall has been depressed relative to the footwall. Footwall is the mass of rock beneath a fault plane. Hanging wall is the mass of rock overlying a fault plane.

Off-Road Vehicle (ORV) - Any vehicle (including the standard automobile) designed for, or capable of, travel on or immediately over land, water, sand, snow, ice, marsh, swampland, or other natural terrain. It includes, but is not limited to: four-wheel drive or low-pressure-tire vehicles, motorcycles and related two-wheel drives, snowmobiles, amphibious machines, ground-effect or air-cushion vehicles, recreation vehicle campers, and any other means of transportation deriving motive power from any source other than muscle, except that such terms exclude motorboats.

Periphery - The external boundary or outward bounds of something.

Pleistocene - The earlier of the two time periods in the Quatenary generally taken to be within the past one million years until the end of the last Ice Age about 11,000 years ago.

Primitive Area - A natural, wild and undeveloped area essentially removed from the effects of civilization.

Protohistoric - Pertaining to the period immediately prior to the beginnings of written history within a geographic region.

Quality Evaluation - A comparative measure of the quality of recreation use opportunities on BLM lands.

Rehabilitation - A short-term management alternative which returns existing negative visual impacts to a desired visual quality.

Rhizomatous - Having rhizomes, an underground stem, as evidenced by the presence of nodes and leaf scales. Rhizomes often spread many feet just under the surface of the soil, and young plants arise, sometimes from each node.

Rockhounding - The collecting of any rock or mineral specimen for recreational purposes.

Scenic Quality - The quality of the scenery as determined through the use of the scenic evaluation process.

Seismicity - Pertaining to, characteristic of, or produced by earthquakes or earth vibration, as seismic disturbances.

Seldom Seen - Areas that are seen from low-use volume transportation routes or are beyond the 15-20 mile background zone for other routes.

Sightseeing - Intentional or inadvertent observation of the natural resource lands or the attractions and resources thereon.

Strike-Slip Fault - A fault in which movement is practically in the direction of the fault strike. Fault strike is the direction of the intersection of the fault surface with a horizontal plane.

Subsidence - A sinking of a large part of the earth's crust.

Texture - The visual result of the tactile surface characteristic of an object.

Tufa - A sedimentary rock composed of calcium carbonate or of silica, deposited from solution in the water of a spring or of a lake or from percolating ground water.

THC (Total Hydrocarbons) - An air measurement.

Visual Prominence Zones - The area that can be seen as foreground-middleground-background, or seldom seen.

Visual Resource Management (VRM) - The planning, design and implementation of visual resource management classes for all BLM resource management activities.

Visual Sensitivity Level - An index of the relative importance or value of visual response to an area in relation to other areas.

Windrose - A circular chart showing wind speed and wind direction in percent.

Windward - Situated toward the direction from which the wind is blowing, upwind.

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